SAUGET AREA 2,
SAUGET, IL



# RI/FS SUPPORT SAMPLING PLAN VOL. 2A

## WASTE, SOIL, STORMWATER, GROUNDWATER & AIR FIELD SAMPLING PLAN

*Prepared for*

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September 10, 2001
Project No. 23-20010024.02

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## 1.1 INTRODUCTION

In response to the requirements of an Administrative Order on Consent (AOC) the Sauget Area 2 Sites Group (SA2SG) will perform a Remedial Investigation/Feasibility Study (RI/FS) at Sauget Area 2 Sites O, P, Q, R, and S.

A Site Sampling Plan (SSP) has been developed to gather sufficient information from the Sauget Area 2 sites to identify the nature of waste materials at Sites O, P, Q, R, and S and to assess the extent of migration of site-related constituents via the soil, groundwater, surface water, sediment, and air pathways and determination of constituent concentrations in aquatic and terrestrial biota. The main components of the SSP addressed in this Field Sampling Plan (FSP) include:

- Source area sampling (soil gas sampling, waste sampling, buried drum and tank identification)
- Groundwater sampling (upgradient, fill areas, downgradient alluvial aquifer, bedrock slug tests, and grain size analysis)
- Soil sampling (waste areas and background)
- Air sampling
- Treatability test sampling
- Stormwater sampling (exit routes from Sites Q and R).

A complete site description for the Sauget Area 2 Sites is provided in Volume 1, Support Sampling Plan. This discussion addresses sites location and physical setting, a discussion of present and past facility operations and disposal practices for each site, a discussion of the regional and site-specific geology, hydrology and hydrogeology, current and past groundwater uses, surrounding land use and populations, sensitive ecosystems, and meteorology/climatology.

URS will perform the field activities, prepare the report, and provide project management for support sampling activities. Analytical services for this FSP will be provided by either Severn-Trent Laboratories - Savannah (Savannah Labs) in Savannah, Georgia and/or Lancaster Laboratories (Lancaster Labs) in Lancaster, Pennsylvania. Analytical services for dioxin and dibenzofuran for this SSP will be provided by Triangle Laboratories, Inc. (Triangle Labs) in Durham, North Carolina. AMEC Environmental, Inc. will perform the Ecological Risk Assessment, and ENSR will perform the Human Health Risk Assessment. The responsibilities of key project personnel are described below. The responsibilities of key laboratory personnel are described in section 2.5 of the QAPP.

## 2.1. PROJECT ORGANIZATION

Sections 2.2 through 2.4 of this FSP present the responsibilities of the key project personnel and the lines of authority for the project personnel are described in each section.

## 2.2 MANAGEMENT RESPONSIBILITIES

### 2.2.1 USEPA Region V Remedial Project Manager

Michael Ribordy will serve as the USEPA Region V Remedial Project Manager (USEPA RPM). As such, he will have overall responsibility for all phases of the SSP.

### 2.2.2 Illinois Environmental Protection Agency (IEPA) Remedial Project Manager

Candy Morin will serve as the IEPA Remedial Project Manager.

### 2.2.3 SA2SG Remedial Project Manager

Steven D. Smith of Solutia Inc. will serve as the SA2SG Project Coordinator. As such, he will have the overall responsibility for all phases of the SSP. He will be responsible for implementing the project, and will have the authority to commit the resources necessary to meet project objectives and requirements. His primary function is to verify that technical, financial, and scheduling objectives are achieved successfully. He will provide the major point of contact and control for matters concerning the project. The SA2SG Project Coordinator will:

- Define project objectives and develop a sampling plan schedule
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task

- Acquire and apply technical and financial resources as needed to verify performance within budget and schedule constraints
- Monitor and direct the field leaders
- Develop and meet ongoing project staffing requirements
- Review the work performed on each task to verify its, quality, responsiveness, and timeliness
- Review and analyze overall task performance with respect to planned requirements and authorizations
- Approve reports before their submission to USEPA Region V
- Ultimately be responsible for the preparation and quality of reports
- Represent the SA2SG at meetings.

### 2.2.4 URS Project Officer

Robert B. Veenstra will serve as the URS Project Officer. As such, he is responsible for the overall administration and technical execution of the project. He will report directly to the SA2SG Project Coordinator.

### 2.2.5 URS Project Manager

Robert B. Billman will serve as the URS Project Manager (PM). As such, he will have overall responsibility for verifying that the project meets the stated objectives and URS's quality standards. He will report directly to the URS Project Officer and is responsible for technical quality control and project oversight.

## 2.3 Quality Assurance (QA) Responsibilities

### 2.3.1 URS Data Validator

John Kearns of URS will serve as the lead third party data validator. As such, he will remain independent of direct job involvement and day-to-day operations and have direct access to corporate executive staff as necessary to resolve QA disputes. The data validator will be responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, URS's policies, and USEPA requirements. The specific functions that he or a designee perform may include:

- Providing QA audits on various phases of the field operations
- Reviewing and approving the QA plans and procedures
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the SA2SG Project Coordinator
- Data validation of sample results from the analytical laboratory, as appropriate.

### 2.3.2 URS QA Officer

Steven Shroff will serve as the URS QA Officer (QAO). As such, he will report directly to the URS Project Officer and will be responsible for verifying that all URS QA procedures for this project are being followed. In addition, he will be responsible for seeing that internal laboratory audits are conducted as specified in Section 10.

### 2.3.3 USEPA Region V Quality Assurance Reviewer

Michael McAteer, the USEPA Region V RPM, or a designee, will serve as the USEPA Region V Quality Assurance Reviewer. As such, he will have the responsibility to review and approve the QAPP. In addition, he will be responsible for conducting external performance and system audits of the laboratory and field activities, and reviewing and evaluating analytical laboratory and field procedures.

## 2.4 FIELD RESPONSIBILITIES

### 2.4.1 URS Field Leader

Steven Shroff, or a designee, will serve as the URS Field Leader. He will be responsible for leading, coordinating, and supervising the day-to-day field activities. His responsibilities include:

- Provision of day-to-day coordination with the URS PM on technical issues
- Develop and implement field-related sampling plans and schedule
- Coordinate and manage field staff
- Supervise or act as the field sample custodian
- Implement the QC for technical data, including field measurements

- Adhere to work schedules
- Authorize and approve text and graphics required for field team efforts
- Coordinate and oversee technical efforts of subcontractors assisting the field team
- Identify problems at the field team level, resolve difficulties in consultation with the URS PM, implement and document corrective action procedures, and provide communication between team and upper management
- Prepare the final report.

### 2.4.2 URS Field Team

The technical staff will be drawn from URS's pool of resources. The technical staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. The technical staff are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

# SECTIONTHREE Project Scope and Objectives

The purpose of the FSP is to gather sufficient information from the Sauget Area 2 Sites to identify the nature of waste materials in Sites O, P, Q, R, and S and to assess the extent of constituent migration in soil, groundwater, surface water, sediments, and air at the site.

Collected data will be used by others to prepare a Human Health Risk Assessment (HHRA), an Ecological Risk Assessment (ERA), and an RI/FS. The RI/FS SSP and this FSP include a description of the sample media, sample locations, number of samples, and analytical methods.

The main components of the SSP addressed in this FSP include:

- Sites O, P, Q, R, and S source area sampling (soil gas sampling, waste sampling, buried drum and tank identification)
- Groundwater sampling (upgradient, fill areas, downgradient alluvial aquifer, bedrock, slug tests, and grain size analysis)
- Soil sampling (Sites O, P, Q, R, and S areas and background)
- Air sampling
- Treatability test sampling
- Stormwater sampling (exit routes from Sites Q and R).

Site plans showing sampling locations are located in Figures 1 through 12 of this FSP.

## 3.1 SITE CHARACTERIZATION

The November 24, 2000 Administrative Order on Consent Scope of Work identified the site characterization information needed to define the extent of contamination at Sauget Area 2.

Sections 6 to 10 of the SSP and Section 5 of this FSP address activities designed to provide site characterization data. The sections describe the number, types, and locations of additional samples that will be collected as part of the SSP.

### 3.1.1 Waste Characterization

The AOC SOW requires inclusion of a program in the SSP for characterizing the waste materials at the Sauget Area 2 Sites including an analysis of current information/data on past disposal practices, test pits/trenches, and deep soil borings to determine waste depths and volume and extent of cover over fill areas, soil gas surveys on and around fill areas, and geophysical delineation of potential drum removal areas. Based on the AOC SOW requirements and a review of the 1998 Ecology and Environment report, the identified waste characterization data include:

- Past disposal practices
- Waste depths and volumes
- Extent of cover over fill areas
- Soil gas survey on and around fill areas
- Buried drum and tank identification.

Section 6 of the SSP, Waste, Soil, and Stormwater Sampling Plan, describes the work that will be performed to obtain waste characterization data.

### 3.1.2 Hydrogeology

The AOC SOW requires inclusion of a program in the SSP for performing a hydrogeologic investigation at the Site including assessment of the degree of hazard, regional and local flow direction and quality.

In addition, the SSP was required to develop a strategy for determining horizontal and vertical distribution of contaminants and to include slug tests, grain size analyses and upgradient samples. Based on the AOC SOW requirements and a review of the 1998 Ecology and Environment report, the identified groundwater characterization data include:

- Regional and local flow direction and quality
- Horizontal and vertical distribution of constituents
- Slug tests
- Grain size analyses
- Upgradient samples.

Section 7 of the SSP, Groundwater Sampling Plan, describes the work that will be performed to obtain groundwater characterization data.

### 3.1.3 Soil

The AOC SOW requires inclusion of a program in the SSP for performing a soil investigation at the Sauget Area 2 Sites to determine the extent of contamination of surface and subsurface soils. Sampling of leachate from the fill areas was also required. Based on the AOC SOW requirements and review of the 1998 Ecology and Environment report, soil characterization data include:

- Extent of contamination of surface and subsurface soils
- Leachate samples from fill areas

Section 6 of the SSP, Waste, Soil and Stormwater Sampling Plan, describes the work that will be performed to obtain soil characterization data.

### 3.1.4 Air

The AOC SOW requires inclusion of a program in the SSP to determine the extent of atmospheric contamination from the various source areas at the Sauget Area 2 Sites and to address the tendency of substances identified through waste characterization to enter the atmosphere, local wind patterns, and their degree of hazard. Based on the AOC SOW requirements and review of the 1998 Ecology and Environment report, air characterization data include:

- Tendency of constituents to enter the atmosphere
- Tendency of constituents to enter local wind patterns
- Degree of hazard.

Section 9 of the SSP, Air Sampling Plan, describes the work that will be performed to obtain air characterization data.

### 3.1.5 Pilot Treatability Tests

The AOC SOW requires inclusion of a program in the SSP for any pilot tests necessary to determine the implementability and effectiveness of technologies where sufficient information is not otherwise available. Based on the AOC SOW requirements and a review of the 1998 Ecology and Environment report, pilot treatability tests include:

- Off-site incineration
- Off-site disposal
- On-site thermal desorption
- On-site physical/chemical leachate treatment
- Off-site physical/chemical leachate treatment
- Off-site biological leachate treatment.

Section 10 of the SSP, Treatability Testing Plan, describes the work that will be performed to perform these pilot treatability tests.

### 3.1.6 Stormwater

In order to characterize stormwater runoff from Sites Q and R, grab samples will be collected during storm events from each disposal area at locations representing the primary drainage route from each site to the Mississippi River. First flush samples will be collected at each site for three storm events using an automated sampling device.

Section 6 of the SSP, Waste, Soil, and Stormwater Sampling Plan, describes the work that will be performed to obtain stormwater characterization data.

## 3.2 PROJECT SCHEDULE

The estimated project schedule is presented in Volume 1, Section 15 of the SSP.

## 4.1 TOPOGRAPHIC MAP AND SAMPLE LOCATION SURVEYING

### 4.1.1 Topographic Map

Surdex, an aerial photography and mapping subcontractor, flew the study area in late March 1999 and again in early 2001 to obtain current aerial photographs of the study area, prior to the spring emergence of vegetation. These photographs, combined with ground control surveying, will be used to prepare a topographic map of the study area with a 1 inch = 50 foot scale and a topographic contour interval of 1 ft. (This map will meet National Map Standards with a horizontal accuracy of +1- 1.25 ft and a vertical accuracy for contour lines of +1- 0.5 ft.)

### 4.1.2 Location And Elevation Surveying

Information submitted to USEPA Region V and IEPA describing sampling locations will be identified in the field using a global positioning satellite (GPS) system. It will be capable of producing decimal latitude and longitude readings and it will have a horizontal accuracy of one meter or less. Well elevations will be surveyed to an accuracy of ±0.01 ft. Information submitted to USEPA Region V and IEPA will be in a Microsoft Excel®-compatible electronic spreadsheet and will include columns on:

- Latitude (decimal degrees)
- Longitude (decimal degrees)
- Sample identification
- Sample description (e.g., soil, groundwater)
- Locational method
- Sample depth
- Time and date of sample collection
- Time and date of sample analysis
- Chemical parameter
- Chemical result
- Analysis method
- Detection limit

- Chemical units (ppm, ppb, mg/kg, etc.)
- Result qualifier (non-detect, etc.).

## 4.2 AERIAL PHOTOGRAPH ACQUISITION AND ANALYSIS

Available historical air photographs not included in the 1988 Ecology and Environment report will be obtained for Sites O, P, Q, R, and S. These photographs, and the results of the E&E evaluation, will be used to define the areal extent of each site. Boundaries of the waste disposal areas will be defined using historical aerial photographs to establish the areal extent of excavation and fill areas over time. For each photo, the boundaries of Sites O, P, Q, R, and S will be traced and input into an AutoCAD file. To define the extent of fill, the AutoCAD files will be overlain for each site and a line will be drawn around the outside boundary of the composite fill areas. If stereoscopic evaluation of historical aerial photographs allows identification of the deepest portion of the fill area, one of the four waste characterization borings, for each site, will be conducted at that location.

Results of the analysis of historical aerial photographs will be used to prepare a map for each site, showing fill area boundaries and the final selected locations of the boundary confirmation trenches and the waste characterization borings. When the map for each fill area is completed, it will be submitted to USEPA Region V for acceptance prior to performance of the boundary confirmation trenching or collection of the waste characterization samples. Boundary confirmation trenches and waste characterization borings will be located in the field by measuring from known points, such as buildings, roads, or other cultural features or by using GPS.

# SECTIONFIVE Field Activities by Site

Rationale and field activity discussions have been developed for each of the five sites on a site by site basis. There are however, several types of field activities which are common to all of the sites, such as documentation, QA/QC activities, equipment decontamination, and handling of investigation derived waste. Discussion of these topics are presented below.

## DOCUMENTATION

All URS personnel will keep a bound field notebook while performing sampling and oversight activities on-site. The field notebook will contain general information including but not limited to:

- Date, time, weather conditions, equipment, and personnel on site
- Site in which the work was performed
- Specific work activities conducted
- PID, CGM, and RAM readings.

In addition to the general information discussed above, the field notebook will also contain specific information regarding the daily work activities. This information will include but is not limited to:

- Samples collected
- Depth of borings or trenches
- Observations of site conditions
- All changes to the Scope of Work or Health and Safety procedures.

The minimum documentation requirements for the field notebooks are provided in Section 6 of this FSP.

## QA/QC

To verify field and laboratory procedures, quality assurance/quality control (QA/QC) samples consisting of duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, field blanks and trip blanks will be collected and submitted to the laboratory. The sampling procedures and frequency will follow QA/QC Standard Operating Procedures (SOP) in Appendix B of this FSP.

All samples (including QA/QC samples) will be tracked using appropriate Chain-of-Custody documentation. The Chain-of-Custody procedures are described in Section 6.1.3 of this FSP. A sample chain-of-custody form is also presented in Appendix F.

### Decontamination

In order to reduce the potential for exposure to hazardous materials and limit the possibility of cross contamination of samples, all personnel and equipment will be subject to the decontamination program for this project. All equipment used on-site, from a small handheld PID to a large conventional drilling rig, will be decontaminated prior to beginning work, between sampling locations and/or uses, and prior to demobilizing from the site. Several decontamination stations will be established throughout Area 2. Refer to Section 9 of this report for a discussion of the proper decontamination procedures.

### Investigation Derived Waste

All Investigation Derived Waste (IDW) ranging from soil cuttings and purge water to recovered drums, will be placed in containers such as over-pack drums or roll-off containers. The various containers will be stored within a central fenced storage area pending appropriate disposal. The proper procedures for waste disposal are discussed in Section 9 of Volume 2C, The Health and Safety Plan.

The following subsections correspond to the activities to be conducted at the individual Area 2 Sites:

- Section 5.1 Site O
- Section 5.2 Site P
- Section 5.3 Site Q
- Section 5.4 Site R
- Section 5.5 Site S
- Section 5.6 Background Locations
- Section 5.7 Area 2 Groundwater Flow Direction and Flow Rate

## 5.1 SITE O

### 5.1.1 Waste Characterization

#### 5.1.1.1 Delineation of Source Area Boundaries – Test Trenches

**Rationale**

Historical air photos will be obtained for this site. These photos will be used to define the areal extent of the site over time and to determine the boundaries of the waste disposal area. Boundaries of the site on each photo will be observed. To define the maximum extent of fill, the tracings for the site will be overlain and a line will be drawn around the outside limit of the composite waste disposal area boundary. Results of the historical air photo analysis will be used to prepare a map for the site, showing disposal area boundaries. If stereoscopic evaluation of historical air photographs allows identification of the deepest portion of a waste disposal area, one of the four waste characterization borings discussed below will be done at that location.

Test trenches will be used to confirm the boundaries of the waste disposal area identified through air photo analysis. One trench will be installed on each side of the waste disposal area. Thus, there will be a total of four trenches for the site. The four trenches will be located at the midpoint of the four longest sides of the defined site boundary. A GPS system will be used to document the locations on aerial site maps. Test trenches will start outside the defined boundary of the disposal area and move toward the defined boundary. When fill materials are encountered, the disposal area boundary will be compared to those identified in the air photo analysis and trenching at that location will then be terminated.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. Intact drums will be removed, provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums due to the inherent danger in such activities. Test trench locations will be determined using a GPS system. The trench locations will be recorded for future reference, in the event drum removal is appropriate. The drum removal contractor, in accordance with the requirements of 29 CFR 1910.120(j) will handle drums recovered during trenching activities. Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials. The absorbent, solid waste, and contaminated soil will be placed in bulk containers. The over-pack drums and these bulk containers will be temporarily stored at a controlled-access, fenced Investigation Derived Waste

(IDW) Storage Area to be constructed at Site R. Recovered drums and wastes will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

Trenching locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

**Field Procedure**

All trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow Occupational Safety and Health Administration (OSHA) rules for excavations.

Locations of test trenches for boundary confirmation of Site O are shown on Figure 2. A "competent" person, as defined in 29 CFR 1976.650, will observe the trenching activities and will have authorization to take corrective measures to respond to unsanitary, hazardous, or dangerous conditions to workers. A track-mounted hoe with an extended arm will be used for excavation. A photoionization detector (PID), combustible gas monitor (CGM), and a real-time aerosol monitor (RAM) will be used on a continuous basis to monitor the test trenches for hazardous conditions.

Trenching activities will begin outside the site boundary and move in towards the boundary. The trenching will extend vertically to a maximum depth of 40 ft bgs or to groundwater, whichever is encountered first. No accommodations will be made to dewater test trenches or manage groundwater during excavation activities in order to minimize the generation of investigation-derived wastes. The trenching will continue until waste material is encountered. Should waste materials be encountered initially, the trenching activities will proceed out and away from the boundary until native soils are encountered. Where native soils are encountered, the excavation will proceed to greater depth up to a maximum of 40 ft below grade, where possible. Should waste materials be encountered again within the test trench, this procedure will be repeated until no waste materials are encountered within the test trench. The location where no additional waste materials are encountered within the test trench will be designated as the extent of the site boundary for that location.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic, having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. The gross contamination will be removed from the excavator bucket with a shovel and/or potable water source prior to handling the cover material. Decontamination debris will be placed into the excavation trench prior to placement of cover material. Handling of investigation-derived wastes from these activities is discussed in Section 9.

Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

The location of the test trenches will be illustrated on a plan of the site. Digital photographs will be taken of the test trenches, the test trench walls, and any waste materials excavated. The number and location of each photograph will be identified on the field log for each test trench.

#### 5.1.1.2 Soil Gas Surveys

**Rationale**

A soil gas contractor will perform a soil gas survey at Site O. A shallow soil probe (5 feet) and on-site analysis of collected VOC vapors with a GC will be used in this survey. Soil gas samples will be collected at the center points of a 200 by 200 ft grid, superimposed on the disposal area, resulting in approximately four sampling locations. The soil gas survey sampling grid for Site O is displayed in Figure 3.

If detectable concentrations of Total VOCs are found in the soil gas samples at the disposal area boundary, the survey will be extended beyond that boundary. If extended beyond the site boundary, soil gas samples will be collected at 100-foot intervals (0, 100, and 200 feet from the edge of the disposal area) along as many as four 200-foot long transects. Each transect will run perpendicular to the relevant side of the disposal area. If VOCs are detected in soil gas at this site, up to twelve additional soil gas samples may be collected.

If twelve additional samples are not adequate to define the extent of VOC-containing soils in the disposal area, additional soil gas samples will be collected at 100-foot intervals along the appropriate transects until the limits of the impacted fill are determined. If soil gas surveys need to extend into areas for which there are no property access agreements, soil gas sampling will be suspended until access is obtained.

Sampling locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

Table 2 is a sample and analysis summary for this activity.

**Field Procedure**

Direct push technology will be used to advance a retractable point holder to 5.5 feet below existing grade. The rods will then be pulled back to approximately 5 feet below existing grade to disengage the retractable point, therefore, exposing the sampling mechanism. Polyethylene tubing (0.125-inch diameter) will be lowered into the rods. The upper end of the polyethylene tubing will be connected to a 4-inch section of silicone tubing. This will then be attached to a section of polyethylene tubing coming from an active vacuum system and a vacuum will be placed in the tubing. A 60cc sample of soil gas will be withdrawn from the silicone tubing using a 60cc disposable syringe with a stainless steel needle. The sample will then be directly injected into the on-site GC. The GC will provide a report of the total VOC concentrations.

Sample tubing will be removed from the probe and disposed. Probing rods and sampling equipment will be removed from the boring. The probe boring will be filled with bentonite, to just bgs. The bentonite will be hydrated with potable water and the surface will be restored to its original condition. An SOP for the field GC is contained in Appendix A.

### 5.1.1.3 Waste Samples

**Rationale**

Four borings will be advanced at this site to characterize the waste materials present. Continuous samples will be collected from grade to two feet below the bottom of the waste material, which is estimated to be a maximum of 40 feet below grade. If wastes are encountered at depths greater than 40 feet bgs (bgs), the boring will continue until the bottom of the waste is encountered.

Scaled, color digital photographs will be taken of each waste sample to provide a record of materials present in the disposal area.

One composite waste sample will be collected at each boring location (4 total composite waste samples), and analyzed for SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. In addition, a portion of the composite waste sample from above the water table will be extracted using TCLP procedures and analyzed for this same suite of analytes. Visual observations and PID readings will be used to identify whether or not waste is present in a continuous boring sample. If waste is present in a sample, it will be removed, segregated, temporarily stored and used at the completion of the soil boring to prepare a composite waste sample. Since VOC samples cannot be composited without losing volatiles, the waste with the highest PID readings will be used for VOC analysis.

Existing information (e.g., the 1998 Ecology and Environment report and the results of the aerial photograph analysis, and soil gas surveys conducted as part of the SSP) will be used to select boring locations. Approximate waste characterization boring locations for Site O are shown on Figure 2. Additional waste characterization borings may be required by USEPA Region V as a result of variability in waste characteristics observed during the waste characterization boring program.

Table 3 is a sample and analysis summary for waste samples to be collected.

### Field Procedure

Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depths. Continuous samples will be collected from grade to 2 feet below the bottom of the waste material (estimated to be 40 feet bgs). Between each sample collection, the sampler will be retrieved to the surface and the samples removed from the disposable acetate liner within the sampler.

One composite waste sample will be collected from each boring. Each sample will be visually observed and monitored with PID readings, to determine whether waste is present. If waste is present in a sample, it will be removed, segregated, temporarily stored, and used at the completion of the soil boring to prepare a composite waste sample. The sample exhibiting the highest PID reading at each of the four boring locations within this site will be used for VOC analysis A 5-gram EnCore® sampler will be used to collect VOC samples.

Refer to Appendix C for detailed soil/waste sampling procedures.

Descriptive logs of each boring will be prepared as described in Appendix E. The four waste borings generated at each of the five sites will also be used for surface and subsurface soil sample collection. All borings will be grouted to the surface, following retrieval of both the waste and soil samples.

**Logging Unconsolidated Samples**

The geologist logging samples will be responsible to interpret the samples following standard and acceptable methods. The geologist implementing this work plan will have training and experience logging boring samples. Soil will be logged according to applicable ASTM standards. As appropriate, ASTM standards will be used to log waste materials. Appendix E presents detailed instructions for logging soil and waste samples.

#### 5.1.1.4 Buried Drum and Tank Identification

**Magnetometer Survey**

A magnetometer survey is typically conducted to identify anomalies indicative of drum disposal or buried tanks. Magnetometer measurements will not be made at Site O because it was closed under the supervision of Sauget P/Chem Plant personnel in 1980. No drums were present at the time of closure.

**Test Trenches**

Test trenches will not be installed at Site O because it was closed under the supervision of Sauget P/Chem Plant personnel in 1980. No drums were present at the time of closure.

#### 5.1.1.5 Leachate Samples

**Rationale**

A 2-inch diameter well, screened at the bottom of the fill material, will be installed in one of the four waste characterization borings completed at this site. The purpose of this well is to characterize leachate at the site. The well will be sampled and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. The analytical methods are presented in Table 1.

### Field Procedure

#### Well Installation

The depth and screened interval for the well will be determined in accordance with the subsurface stratigraphy observed during Geoprobe® waste sampling activities. It is expected that the waste at the site extends to approximately 40 feet bgs. Unless observed conditions indicate otherwise, a screened interval of 10 feet will be used. The well will be seated at the bottom of the waste. A 4-1/4 inch ID hollow-stem auger will be used to advance the boring to the bottom of the waste material. The well will be constructed of two-inch diameter, schedule 40 PVC casing and 0.010-inch slotted schedule 40 PVC well screen. A sand pack, consisting of silica sand, will be installed from the bottom of the well to two feet above the well screen. A bentonite seal with a thickness of between 2 feet and 3 feet will be installed directly above the sand pack. The remaining annular space will be filled with a bentonite and cement grout. The well will be completed with an aboveground well protector and a locking cap.

Following installation of the leachate well, the top of casing and ground surface will be surveyed to establish well and grade elevations and well location. Well installation details will be documented on a test boring log (Appendix D) and in the field notebook. The leachate well will generally be installed according to the typical well construction diagrams and standard procedures presented in Appendix G.

Following completion of monitoring well construction activities, the water level will be allowed to stabilize and will then be gauged to determine groundwater elevation and the total volume of groundwater in the well. After the water level in the well has been determined, the well will be developed to remove the fines from the sand pack. The development will consist of pumping or bailing the well, following the protocol described later in this section.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 2 displays the approximate leachate monitoring cell location for Site O.

**Well Development**

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

**Well Purging (if necessary)**

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

**Water Level Measurements**

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

**Groundwater Pre-Sampling and Well Sampling**

Appendix I presents the protocol for groundwater sampling activities.

### 5.1.2 Hydrogeology

#### 5.1.2.1 Alluvial Aquifer

**Horizontal Extent of Contaminant Migration**

**Rationale**

Groundwater samples will be collected in the alluvial aquifer downgradient of this waste disposal area. The purpose of this sampling is to define the extent of migration away from the source area and to provide information for the Human Health Risk Assessment.

Groundwater samples will be collected at three sampling stations located on an east/west transect between the downgradient boundary of Site O and the upgradient boundary of Sites Q and R. Unfiltered groundwater samples will be collected every 10 feet from the water table to the bottom of the aquifer using push sampling technologies such as Geoprobe®, HydroPunch®, Microwell®, Waterloo Profiler® or equivalent low-flow sampling techniques. Aquifer saturated thickness is estimated to be approximately 120 feet with depth to water at 20 feet bgs and bottom of the aquifer at 140 feet bgs. All samples will be analyzed for VOCs and SVOCs. Additionally, unfiltered samples will be collected at 40 foot intervals (i.e., 20, 60, 100, 140 feet bgs) for analysis of pesticides, herbicides, PCBs, metals and several geochemical parameters (presented in Table 1). Dioxin will be analyzed only at the sampling station closest to Site O. For dioxin analysis, unfiltered groundwater samples will be collected at the top, middle, and bottom of the saturated zone (e.g., 20, 80, 140 feet bgs).

Experience at other sites indicates that push-sampling technologies such as Geoprobe® can reach depths of 60 feet. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe® sampler or equivalent sampling technology cannot penetrate to the required depth, Microwells® will be used to collect groundwater samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 feet can be achieved. If the required sampling depths cannot be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the alluvial aquifer groundwater sampling is presented in Table 4.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Area 2.

### Field Procedure

### Establishment of Boreholes

### Push Point

Using the hydraulic push system of a Geoprobe®, a 4-foot stainless steel sampler with a wire wrap (slot size of 0.004 inches) will be pushed to the desired sample depth. A bailer or ball and check valve will be sent down to the slotted portion of the sampler to collect the groundwater sample. The groundwater sample will be retrieved to the surface and placed in a sample container. The Geoprobe® will then drive the sampler to the next desired sample depth, by connecting clean sections of push rods to the Geoprobe®, and a second groundwater sample will be collected here. This process will be continued until all samples are collected.

**MicroWell®**

It is anticipated the above sampling method will be used, as feasible. However based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered, which will stop the Geoprobe®. Should this occur, MicroWells® will be installed to use as the sample collection point. The MicroWells® will be hydraulically pushed to the appropriate depth, and the sampling procedure described above will be followed. Once the sample is collected, the MicroWell® will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced further in the same hole. This procedure will be repeated until all samples are collected.

Should MicroWell® installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which groundwater will flow. Once the sample is collected, the augers will be advanced further for collection at the next sample depth. This procedure will be repeated until all samples are collected within the borehole.

All Geoprobe®, MicroWell®, or Waterloo Profiler® holes will be sealed with grout from the bottom up and the surface will be returned to it's original condition after completion of sampling at each location. A PID, explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

**Groundwater Pre-Sampling and Borehole Sampling**

Appendix I presents the protocol for groundwater sampling activities.

**5.1.2.2 Bedrock Groundwater**

**Vertical Extent of Contaminant Migration**

**Rationale**

One bedrock well will be installed downgradient of this site. The purpose of the bedrock sampling is to determine the extent of organic and inorganic constituent vertical migration from the site. Steel surface casing will be installed 5 feet into bedrock.

After installing the surface casing 5 feet into bedrock, the bedrock will be cored to a depth of 20 feet below the bottom of the casing. Cores will be digitally photographed in color against a scale and evaluated for porosity by examination and petrographic thin sections. One thin section will be made for each 2 feet of bedrock core. A 2-inch diameter, 5-foot-long screen and casing will be installed in the borehole. The screen will be filter-packed, sealed and grouted from 3 feet above the top of the filter-pack to grade. An unfiltered groundwater sample will be collected from the well following installation and development and will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the bedrock groundwater sampling is presented in Table 5.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Site O.

### Field Procedure

Mud rotary drilling methods will be used to drill the borehole to set the surface casing and to drill 5 feet into the top of bedrock. Coring will then be accomplished using wireline coring barrels to generate a 2-inch thick minimum core. Coring will continue for 20 feet into the bedrock. The drilling and sampling procedure will be as follows:

1. A temporary 10-inch ID steel casing will be installed from ground surface to 10 feet bgs. A bentonite/cement grout will be used to fill the annular space.
2. A 8-3/4-inch ID tri-cone bit will then be used to drill down to 145 feet. A 5-inch ID steel casing will be installed from ground surface to 145 feet bgs. A bentonite/cement grout will be used to fill the annular space.
3. Wireline coring barrels (NX rods) will be used to core 20 feet into the bedrock (165 feet bgs). The coring barrels will be retrieved and opened to collect the core sample.
4. Core samples will be photographed and described on test boring logs. Descriptions will follow the procedures outlined below.
5. The borehole will then be reamed to a 4-7/8-inch diameter. A 2-inch PVC casing (schedule 80) will be installed from ground surface to 165 feet bgs (20 feet into bedrock). The PVC casing will have a 5-foot long screen (0.010-inch slots). A bentonite seal with a minimum thickness of two feet will be installed directly above the sand pack. This

bentonite seal will be 3 feet in length. The remaining annular space will be filled with a bentonite and cement grout.

6. The temporary 10-inch I.D. steel casing will be removed and the well will be completed with an aboveground well protector and a locking cap.
7. Well development or purging may be necessary before collecting groundwater samples from the cased/screened hole in the bedrock. The procedures for both well development and well purging are presented below.
8. Water level measurements will then be collected, prior to sampling the bedrock groundwater. The procedure for measuring water levels is also presented below.
9. The bedrock groundwater sample collection method is presented after the procedure for water level measurements.

### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

### Description of Rock Samples

As mentioned earlier in this section, the rock core will be evaluated via photographs and petrographic thin sections. The geologists and geotechnical engineers will write their description of rock samples with a consistent format. A detailed order and presentation of selection of data are presented in Appendix J.

#### Groundwater Flow Direction (water levels)

Water levels will be measured quarterly for one year in the bedrock well and used to prepare water-level elevation maps. These will show seasonal changes in groundwater level and flow direction. Water level measurements will be conducted according to the same protocol outlined in Appendix I.

#### Groundwater Flow Rate (slug tests)

#### Rationale

Falling and rising head slug tests will be performed on the bedrock well, using a slug of known volume and in-well, short-time interval, automatic water-level recorders. With the falling-head and rising-head slug test data, aquifer hydraulic conductivity will be calculated for the well. Measured groundwater gradients and calculated aquifer hydraulic conductivities will be used to determine groundwater flow rates.

#### Field Procedure

Appendix K presents the field protocols for the completion of *in situ* hydraulic conductivity (slug) tests.

Slug test data will be downloaded from the data logger each day. The data will be reviewed for errors. If necessary, a slug test will be re-conducted.

### 5.1.3 Soil

#### 5.1.3.1 Surface Soil Samples

#### Rationale

Four surface soil samples (0 to 0.5 feet) will be collected at this disposal site. These samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment and the Ecological Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the surface soil sampling is presented in Table 6.

Figure 2 presents approximate soil sample locations in Site O.

**Field Procedure**

Surface soil samples will be discrete. A discrete sample represents a single location in the soil column. The soil samples will be collected from the Geoprobe® borings.

Appendix C presents the standard operating procedure for waste and soil sample collection.

#### 5.1.3.2 Subsurface Soil Samples

**Rationale**

Four subsurface soil samples (0.5 to 6 feet) will be collected at each disposal site. As with the surface soil samples, the subsurface samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the subsurface soil sampling is presented in Table 7.

Figure 2 presents approximate soil sample locations for Site O.

**Field Procedure**

The four soil samples collected at this site will be collected at the location of each waste sample boring. The subsurface soil samples will be collected in the same manner as the waste samples.

Appendix C presents the standard operating procedure for waste and soil sample collection.

#### 5.1.4 Air

##### 5.1.4.1 Rationale

Two upwind and two downwind ambient air samples will be collected to determine the tendency of site constituents to enter the atmosphere and local wind patterns. Air sampling data will be used in the Human Health Risk Assessment and Ecological Risk Assessment. Samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and dioxin.

Twenty-four hour cumulative duration sorbent tube/PUF/PM2.5 samples will be collected over a 1-day period, using the sampling protocols provided in Appendix L. Two upwind and two downwind samplers will be installed at the site during weather likely to produce emissions (e.g. hot and dry conditions in August). Sampling locations will be selected in the field with the concurrence of USEPA Region V or his designee. Sorbent tube samplers will be used for VOC data collection. Polyurethane foam (PUF) samplers will be used for SVOC, PCB, pesticide, herbicide, and dioxin data collection. PM2.5 samplers will be used for metal data collection

Ambient air sample collection is required to measure airborne levels of contaminants that may be evolving from the site. A 24-hour sample duration is required to average the air emission differences that may occur from the day time to night time cycle from on-site and off-site conditions and activities. Also, air sample collection locations need to be positioned on the site to collect up wind and down wind samples for differentiation of constituents originating from the surrounding area and those originating from the site. The sample protocol will collect site samples over a 1-day time period on a warm, dry day.

The level of detection for SVOCs required by USEPA Region V needs to consider sensitivity and selectivity to analyze complex samples. Based on this need, the analytical method of choice is gas chromatography coupled with mass spectrometry (GC/MS) for detection. Based on the GC/MS analytical method and its sensitivity level, the air sample volume needs to exceed 325 standard cubic feet. This enables the collection of a sufficient quantity of SVOCs to meet the level of detection required by USEPA Region V.

The sample method to meet the above requirements for SVOC measurement is USEPA Method TO-13, as identified in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (June 1988). This method will use a Graseby/General Metal Works, Inc. high volume air sampling unit or equivalent for sample collection. Sample collection will consist of drawing an ambient air sample at a high volume flow rate through a PUF collection media over a 24-hour time period. The samples will be submitted for analysis of the TO-13 list of SVOCs. Method TO-1 will be used to analyze VOCs. Method TO-13 will be used for pesticides, herbicides, and PCBs. Method TO-9 will analyze for dioxins.

Table 8 is a sample and analysis summary of this activity.

#### 5.1.4.2 Field Procedure

The following procedure will be used for ambient air samples:

- Place the sorbent tube samplers, PUF samplers, and PM2.5 samplers at upwind and downwind locations.
- Locate sampling positions in an unobstructed area, at least two meters from any obstacle to air flow. Sample locations will be selected in the field with the concurrence of the USEPA Region V, or its designee.
- No local power supply is readily available at the sites. Therefore, gasoline- or diesel-powered generators will be positioned at downwind locations from the sample collection positions. They will supply the electricity for the samplers.
- Record wind direction and velocity readings.
- Follow sample collection protocols identified in methods TO-1, TO-4, TO-13, and TO-9 (Appendix C) for sample preparation, calibration, collection, laboratory preparation and shipment, and calculations. Sample data sheets are provided in Appendix L.

### Treatability Tests

#### Rationale

The AOC requires that the SSP present a pilot test program for any treatment technologies lacking sufficient information on implementability and effectiveness. Data gaps exist for off-site incineration, off-site disposal, and on-site thermal desorption for the waste and on-site and off-site physical/chemical treatment, and off-site biological treatment for leachate.

A total of five composite waste samples (one for each site) will be collected for waste treatability testing and sent to appropriate facilities operators for waste profiling, material handling characterization and evaluation of the feasibility of disposing of the waste material by off-site incineration, off-site disposal, and on-site thermal desorption. In addition, five composite leachate samples (one for each site) will be collected for treatability testing to determine if the leachate can be discharged directly to American Bottoms POTW without resulting in pass through and/or interference.

One sample will be collected from each waste disposal area for waste treatability testing. The sample will be made from aliquots collected from the four waste characterization borings installed at each disposal area. One sample will be collected for the leachate treatability testing from each of the five-leachate sampling wells.

#### Sample Collection

The five composite waste samples that will be collected for treatability testing will be retained from the four-waste/soil borings that will be advanced at each waste disposal area. All of the material recovered from the Geoprobe® samples that are not needed for the other chemical analyses will be composited in 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facilities.

The leachate sample that will be collected for treatability testing will be collected during leachate sampling activities. An equal amount of leachate will be removed, via bailer or pump, from each of the five-leachate monitoring wells and placed in separate 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facility.

## 5.2 SITE P

### 5.2.1 Waste Characterization

#### 5.2.1.1 Delineation of Source Area Boundaries – Test Trenches

#### Rationale

Historical air photos will be obtained for this site. These photos will be used to define the areal extent of the site over time and to determine the boundaries of the waste disposal area. Boundaries of the site on each photo will be observed. To define the maximum extent of fill, the tracings for the site will be overlain and a line will be drawn around the outside limit of the composite waste disposal area boundary. Results of the historical air photo analysis will be used to prepare a map for the site, showing disposal area boundaries. If stereoscopic evaluation of historical air photographs allows identification of the deepest portion of a waste disposal area, one of the four waste characterization borings discussed below will be done at that location.

Test trenches will be used to confirm the boundaries of the waste disposal area identified through air photo analysis. One trench will be installed on each side of the waste disposal area. Thus, there will be a total of four trenches for the site. The four trenches will be located at the midpoint of the four longest sides of the defined site boundary. A GPS system will be used to document the locations on aerial site maps. Test trenches will start outside the defined boundary of the disposal area and move toward the defined boundary. When fill materials are encountered, the disposal area boundary will be compared to those identified in the air photo analysis and trenching at that location will then be terminated.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. Intact drums will be removed, provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums due to the inherent danger in such activities. Test trench locations will be determined using a GPS system. The trench locations will be recorded for future reference, in the event drum removal is appropriate. The drum removal contractor, in accordance with the requirements of 29 CFR 1910.120(j) will handle drums recovered during trenching activities. Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials. The absorbent, solid waste, and contaminated soil will be placed in bulk containers. The over-pack drums and these bulk containers will be temporarily stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums and wastes will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

Trenching locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

### Field Procedure

All trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow Occupational Safety and Health Administration (OSHA) rules for excavations.

Locations of test trenches for boundary confirmation of Site P are shown on Figure 5. A "competent" person, as defined in 29 CFR 1976.650, will observe the trenching activities and will have authorization to take corrective measures to respond to unsanitary, hazardous, or dangerous conditions to workers. A track-mounted hoe with an extended arm will be used for excavation. A photoionization detector (PID), combustible gas monitor (CGM), and a real-time aerosol monitor (RAM) will be used on a continuous basis to monitor the test trenches for hazardous conditions.

Trenching activities will begin outside the site boundary and move in towards the boundary. The trenching will extend vertically to a maximum depth of 40 ft bgs or to groundwater, whichever is encountered first. No accommodations will be made to dewater test trenches or manage groundwater during excavation activities in order to minimize the generation of investigation-derived wastes. The trenching will continue until waste material is encountered. Should waste materials be encountered initially, the trenching activities will proceed out and away from the boundary until native soils are encountered. Where native soils are encountered, the excavation will proceed to greater depth up to a maximum of 40 ft below grade, where possible. Should waste materials be encountered again within the test trench, this procedure will be repeated until no waste materials are encountered within the test trench. The location where no additional waste materials are encountered within the test trench will be designated as the extent of the site boundary for that location.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic, having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. The gross contamination will be removed from the excavator bucket with a shovel and/or potable water source prior to handling the cover material. Decontamination debris will be placed into the excavation trench prior to placement of cover material. Handling of investigation-derived wastes from these activities is discussed in Section 9.

Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

The location of the test trenches will be illustrated on a plan of the site. Digital photographs will be taken of the test trenches, the test trench walls, and any waste materials excavated. The number and location of each photograph will be identified on the field log for each test trench.

### 5.2.1.2 Soil Gas Surveys

**Rationale**

A soil gas contractor will perform a soil gas survey at Site P. A shallow soil probe (5 feet) and on-site analysis of collected VOC vapors with a GC will be used in this survey. If extended beyond the site boundary, soil gas samples will be collected at the center points of a 200 by 200 ft grid, superimposed on the disposal area, resulting in approximately four sampling locations. The soil gas survey sampling grid for Site P is displayed in Figure 6.

If detectable concentrations of Total VOCs are found in the soil gas samples at the disposal area boundary, the survey will be extended beyond that boundary. If extended beyond the site boundary, soil gas samples will be collected at 100-foot intervals (0, 100, and 200 feet from the edge of the disposal area) along as many as four 200-foot long transects. Each transect will run perpendicular to the relevant sides of the disposal area. If VOCs are detected in soil gas at this site, up to twelve additional soil gas samples may be collected.

If twelve additional samples are not adequate to define the extent of VOC-containing soils in the disposal area, additional soil gas samples will be collected at 100-foot intervals along the appropriate transects until the limits of the impacted fill are determined. If soil gas surveys need to extend into areas for which there are no property access agreements, soil gas sampling will be suspended until access is obtained.

Sampling locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

Table 2 is a sample and analysis summary for this activity.

### Field Procedure

Direct push technology will be used to advance a retractable point holder to 5.5 feet below existing grade. The rods will then be pulled back to approximately 5 feet below existing grade to disengage the retractable point, therefore, exposing the sampling mechanism. Polyethylene tubing (0.125-inch diameter) will be lowered into the rods. The upper end of the polyethylene tubing will be connected to a 4-inch section of silicone tubing. This will then be attached to a section of polyethylene tubing coming from an active vacuum system and a vacuum will be placed in the tubing. A 60cc sample of soil gas will be withdrawn from the silicone tubing using a 60cc disposable syringe with a stainless steel needle. The sample will then be directly injected into the on-site GC. The GC will provide a report of the total VOC concentrations.

Sample tubing will be removed from the probe and disposed. Probing rods and sampling equipment will be removed from the boring. The probe boring will be filled with bentonite, to just bgs. The bentonite will be hydrated with potable water and the surface will be restored to its original condition. An SOP for the field GC is contained in Appendix A.

## 5.2.1.3 Waste Samples

### Rationale

Four borings will be advanced at this site to characterize the waste materials present. Continuous samples will be collected from grade to two feet below the bottom of the waste material, which is estimated to be a maximum of 40 feet below grade. If wastes are encountered at depths greater than 40 feet bgs (bgs), the boring will continue until the bottom of the waste is encountered. Scaled, color digital photographs will be taken of each waste sample to provide a record of materials present in the disposal area.

One composite waste sample will be collected at each boring location (4 total composite waste samples), and analyzed for SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. In addition, a portion of the composite waste sample from above the water table will be extracted using TCLP procedures and analyzed for this same suite of analytes. Visual observations and PID readings will be used to identify whether or not waste is present in a continuous boring sample. If waste is present in a sample, it will be removed, segregated, temporarily stored and used at the completion of the boring to prepare a composite waste sample. Since VOC samples cannot be composited without losing volatiles, the waste with the highest PID readings will be used for VOC analysis.

Existing information (e.g., the 1998 Ecology and Environment report and the results of the aerial photograph analysis, soil gas surveys, and magnetometer surveys conducted as part of the SSP) will be used to select boring locations. Approximate waste characterization boring locations for Site P are shown on Figure 5. Additional waste characterization borings may be required by USEPA Region V as a result of variability in waste characteristics observed during the waste characterization boring program.

Table 3 is a sample and analysis summary for waste samples to be collected.

### Field Procedure

Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depths. Continuous samples will be collected from grade to 2 feet below the bottom of the waste material (estimated to be 40 feet bgs). Between each sample collection, the sampler will be retrieved to the surface and the samples removed from the disposable acetate liner within the sampler.

One composite waste sample will be collected from each boring. Each sample will be visually observed and monitored with PID readings, to determine whether waste is present. If waste is present in a sample, it will be removed, segregated, temporarily stored, and used at the completion of the boring to prepare a composite waste sample. The sample exhibiting the highest PID reading at each of the four boring locations within this site will be used for VOC analysis. A 5-gram EnCore® sampler will be used to collect VOC samples.

Refer to Appendix C for detailed soil/waste sampling procedures.

Descriptive logs of each boring will be prepared as described in Appendix E. The four waste borings generated at each of the five sites will also be used for surface and subsurface soil sample collection. All borings will be grouted to the surface, following retrieval of both the waste and soil samples.

### Logging Unconsolidated Samples

The geologist logging samples will be responsible to interpret the samples following standard and acceptable methods. The geologist implementing this work plan will have training and experience logging boring samples. Soil will be logged according to applicable ASTM standards. As appropriate, ASTM standards will be used to log waste materials. Appendix E presents detailed instructions for logging soil and waste samples.

## 5.2.1.4 Buried Drum and Tank Identification

### Magnetometer Survey

#### Rationale

A magnetometer survey will be conducted at this site to identify anomalies indicative of drum disposal or buried tanks. Magnetometer measurements will be made at locations determined by superimposing a 50-foot by 50-foot grid on the disposal area.

Surface geophysical surveys, which map the distribution of the strength of the earth's magnetic field, have been proven useful in evaluating shallow and deep subsurface conditions at environmental sites. These geophysical surveys have been used to successfully locate buried objects containing magnetically susceptible materials (e.g., iron and nickel metals). The ability of geophysical equipment to locate buried objects is, for the most part, dependent on:

- The strength and orientation of the magnetic anomaly associated with the buried objects
- The strength and natural variation of the earth's magnetic field in response to local geology
- The influence of man-made surface features (such as power lines, buried utilities, vehicles, electric motors, etc.) which may interfere with the collection of data.

By comparing the known surface and geological conditions to a magnetic survey map that includes mapped surface feature interferences, and understanding possible geologic background effects, it is possible to identify the location of suspicious subsurface features which may represent buried tanks or drum disposal areas.

### Method

A geophysical survey of the site's magnetic field will be completed utilizing a field magnetometer and electromagnetic induction. The field magnetometer measures the strength of the site's magnetic field regardless of the orientation of the magnetic lines of force. During the performance of the geophysical survey, data for the preparation of a field map will be collected. The final product of this survey will include a description of the site, contour maps, and an explanation of how the survey was conducted.

A correction for diurnal and micropulsation time variations is not necessary because the site and anticipated anomalies are relatively small in area (less than 1 square mile), and subsurface anomalies from buried objects of interest should be relatively large (greater than 100 gammas).

The map showing the distribution of magnetic field strength over the site will be compared with the observed field conditions (including the location of known interfering objects such as vehicles, overhead power lines, and surface debris). By comparison, those magnetic anomalies, which cannot be explained by observed site conditions will be presumed to be a result of, buried subsurface material (e.g., drums, tanks, metal debris, etc.). The depth of detection for suspect objects (such as steel drums) may vary according to orientation, method of manufacture and condition, and numbers present. Steel drums, such as those suspected to be present at this site, may be detected to depths of 40 feet.

### Study Area

The area of the properties to be surveyed will be evaluated in the field. Magnetometer surveys will be conducted at a total of four sites (P, Q, R, and S) within Area 2. A general area for Site P survey site has been delineated and provided on Figure 6 (Fill Area Location Map). Overall site dimensions for the survey sites will be adjusted based upon the findings of the source area boundary delineation activities discussed in Section 5.2.1.1.

### Field Procedure

The following field equipment and procedures will be employed during this geophysical investigation.

### Equipment

A Geometrics 858 Cesium or a Geometrics 856AX Total Field Magnetometer will be used to collect the field data. Field procedures and operation of the instruments will be in accordance with the recommended manufacturer's field procedure and application manual.

Calibrated field survey equipment consisting of marked survey line, tape rulers, highway danger cones, and marked wooden stakes will be utilized to establish measurement locations.

### Measurement Point/Grid Surveying

The established survey lines will be marked in the field using a premarked survey line to maintain straight and precise station locations. Profiles will be completed along a straight line with an unobstructed line of sight. The corners of each of the gridded areas will be marked with temporary corner stakes to permit the relocation of the measurement points within each site.

### Data Processing

Following completion of the field phase of investigation, the following data processing will be performed:

- Explanation of where and how the survey was performed
- Description of each of the four sites (P, Q, R, S) in terms of magnetic anomalies detected
- A contour map of these data will be produced showing the location of the measurement points and the corresponding magnetometer reading.

## Test Trenches

### Rationale

Test trenches will be installed at this site to confirm the presence of buried drums of tanks. One test trench will be installed at each site. The waste disposal areas within Area 2 were used for disposal of municipal and industrial waste as well as construction debris. Magnetic anomalies are likely to be numerous, intense, and widespread. If no location criteria other than the presence of a magnetic anomaly is used to determine whether or not a test trench is appropriate, disturbance of a significant portion of each disposal area is likely to result. Excessive trenching could result in unacceptable risks to the community, on-site workers and the environment.

For this reason, four selection criteria will be used to identify where to install each test trench. Test trenching will be done at the location of the largest magnetic anomaly that coincides with:

1 A soil gas concentration high,

2 Drum or tank disposal locations identified by historical air photo interpretation,

3 An area of high groundwater concentrations (greater than 10,000 ppb) as identified by the 1998 Ecology and Environment Data Report, and

4 Major magnetic anomalies reported in the 1988 Ecology and Environment "Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois".

Care will be taken not to place major emphasis on the comparison of historical groundwater concentrations and magnetic anomalies due to the extent of historical industrial groundwater pumping in the area.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. These will be removed, provided confined spaced entry is not needed to retrieve a drum. Trenches will not be entered to recover drums because of the danger inherent in such activities. Test trench locations will be determined using a GPS and recorded for future reference in the event drum removal is appropriate.

Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil, resulting from rupture of drums during removal, will be cleaned up by absorbing any liquid materials and placing the absorbent, solid waste, and contaminated soil in bulk containers. Over-packed drums and bulk solid and liquid containers will be stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the disposal area will be noted in the field log and photographed.

#### Field Procedure

Anomaly test trench locations will be selected in the field based upon the parameters outlined in the Rationale section, and with the concurrence of the USEPA Region V or its designee.

To complete the anomaly test trench, a track-mounted or wheel-mounted hoe will be utilized. The depth to the top of buried anomalies is not expected to extend past 40 feet below grade; thus, a smaller piece of equipment may be utilized for these anomaly test trenches (in comparison to the trenches completed for delineation of the fill area boundaries). Trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching will follow OSHA rules for excavations. A PID, CGM, and a RAM will be used on a continuous basis to monitor the anomaly test trenches for hazardous conditions. The hoe operator will have a separate supplied-air system.

Anomaly test trenches will be advanced until evidence as to the source of the anomaly is found or to a maximum depth of 40 feet, where possible. Should groundwater infiltration and/or poor soil stability result in the inability to complete a test trench to 40 feet, the trenching will be terminated at that location. No accommodations will be made to de-water test trenches or manage groundwater during excavation activities, due to the need to minimize the generation of investigation-derived wastes.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events.

If intact drums are found during anomaly test trench completion, they will be removed, over-packed, and stored in an area to be designated in accordance with the requirements of 29 CFR 1910.120(j). For planning purposes, it is anticipated that up to ten over-packs will be necessary per site and that one day of anomaly test trenching will occur at each of the four sites. Handling of investigation-derived wastes from these activities is discussed in Section 9.

A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

### 5.2.1.5 Leachate Samples

**Rationale**

A 2-inch diameter well, screened at the bottom of the fill material, will be installed in one of the four waste characterization borings completed at this site. The purpose of this well is to characterize leachate at the site. The well will be sampled and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. The analytical methods are presented in Table 1

**Field Procedure**

**Well Installation**

The depth and screened interval for the well will be determined in accordance with the subsurface stratigraphy observed during Geoprobe® waste sampling activities. It is expected that the waste at the site extends to approximately 40 feet bgs. Unless observed conditions indicate otherwise, a screened interval of 10 feet will be used. The well will be seated at the bottom of the waste. A 4-1/4 inch ID hollow-stem auger will be used to advance the boring to the bottom of the waste material. The well will be constructed of two-inch diameter, schedule 40 PVC casing and 0.010-inch slotted schedule 40 PVC well screen. A sand pack, consisting of silica sand, will be installed from the bottom of the well to two feet above the well screen. A bentonite seal with a thickness of between two feet and three feet will be installed directly above the sand pack. The remaining annular space will be filled with a bentonite and cement grout. The well will be completed with an aboveground well protector and a locking cap.

Following installation of the leachate well, the top of casing and ground surface will be surveyed to establish well and grade elevations and well location. Well installation details will be documented on a test boring log (Appendix D) and in the field notebook. The leachate well will generally be installed according to the typical well construction diagrams and standard procedures presented in Appendix G.

Following completion of monitoring well construction activities, the water level will be allowed to stabilize and will then be gauged to determine groundwater elevation and the total volume of groundwater in the well. After the water level in the well has been determined, the well will be developed to remove the fines from the sand pack. The development will consist of pumping or bailing the well, following the protocol described later in this section.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 5 displays the approximate leachate monitoring well location for Site P.

#### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

#### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

#### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

#### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

### 5.2.2 Hydrogeology

#### 5.2.2.1 Alluvial Aquifer

#### Horizontal Extent of Contaminant Migration

#### Rationale

Groundwater samples will be collected in the alluvial aquifer downgradient of this waste disposal area. The purpose of this sampling is to define the extent of migration away from the source area and to provide information for the Human Health Risk Assessment.

Groundwater samples will be collected at three sampling stations located on an east/west transect between the downgradient boundary of Site P and the Mississippi River. Unfiltered groundwater samples will be collected every 10 feet from the water table to the bottom of the aquifer using push sampling technologies such as Geoprobe®, HydroPunch®, Microwell®, Waterloo Profiler® or equivalent low-flow sampling techniques. Aquifer saturated thickness is estimated to be approximately 120 feet with depth to water at 20 feet bgs and bottom of the aquifer at 140 feet bgs. All samples will be analyzed for VOCs and SVOCs. Additionally, unfiltered samples will be collected at 40 foot intervals (i.e., 20, 60, 100, and 140 foot bgs) and will be analyzed for pesticides, herbicides, PCBs, metals, and several geochemical parameters (presented in Table 1). Dioxin will be analyzed only at the sampling station closest to Site P. For dioxin analysis, unfiltered groundwater samples will be collected at the top, middle, and bottom of the saturated zone (e.g., 20, 80, 140 feet bgs).

Experience at other sites indicates that push-sampling technologies such as Geoprobe® can reach depths of 60 feet. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe® sampler or equivalent sampling technology cannot penetrate to the required depth, Microwells® will be used to collect groundwater samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 feet can be achieved. If the required sampling depths cannot be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the alluvial aquifer groundwater sampling is presented in Table 4.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Area 2.

**Field Procedure**

**Establishment of Boreholes**

**Push Point**

Using the hydraulic push system of a Geoprobe®, a 4-foot stainless steel sampler with a wire wrap (slot size of 0.004 inches) will be pushed to the desired sample depth. A bailer or ball and check valve will be sent down to the slotted portion of the sampler to collect the groundwater sample. The groundwater sample will be retrieved to the surface and placed in a sample container. The Geoprobe® will then drive the sampler to the next desired sample depth, by connecting clean sections of push rods to the Geoprobe®, and a second groundwater sample will be collected here. This process will be continued until all samples are collected.

### MicroWell®

It is anticipated the above sampling method will be used, as feasible. However based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered, which will stop the Geoprobe®. Should this occur, MicroWells® will be installed to use as the sample collection point. The MicroWells® will be hydraulically pushed to the appropriate depth, and the sampling procedure described above will be followed. Once the sample is collected, the MicroWell® will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced further in the same hole. This procedure will be repeated until all samples are collected.

Should MicroWell® installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which groundwater will flow. Once the sample is collected, the augers will be advanced further for collection at the next sample depth. This procedure will be repeated until all samples are collected within the borehole.

All Geoprobe®, MicroWell®, or Waterloo Profiler® holes will be sealed with grout from the bottom up and the surface will be returned to it's original condition after completion of sampling at each location. A PID, explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

### Groundwater Pre-Sampling and Borehole Sampling

Appendix I presents the protocol for groundwater sampling activities.

### 5.2.2.2 Bedrock Groundwater

### Vertical Extent of Contaminant Migration

### Rationale

One bedrock well will be installed downgradient of this site. The purpose of the bedrock sampling is to determine the extent of organic and inorganic constituent vertical migration from the site. Steel surface casing will be installed 5 feet into bedrock.

After installing the surface casing 5 feet into bedrock, the bedrock will be cored to a depth of 20 feet below the bottom of the casing. Cores will be digitally photographed in color against a scale and evaluated for porosity by examination and petrographic thin sections. One thin section will be made for each 2 feet of bedrock core. A 2-inch diameter, 5-foot-long screen and casing will be installed in the borehole. The screen will be filter-packed, sealed and grouted from 3 feet above the top of the filter-pack to grade. An unfiltered groundwater sample will be collected from the well following installation and development and will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the bedrock groundwater sampling is presented in Table 5.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Site P.

#### Field Procedure

Mud rotary drilling methods will be used to drill the borehole to set the surface casing and to drill 5 feet into the top of bedrock. Coring will then be accomplished using wireline coring barrels to generate a 2-inch thick minimum core. Coring will continue for 20 feet into the bedrock The drilling and sampling procedure will be as follows:

1. A temporary 10-inch ID steel casing will be installed from ground surface to 10 feet bgs. A bentonite/cement grout will be used to fill the annular space.
2. A 8-3/4-inch ID tri-cone bit will then be used to drill down to 145 feet. A 5-inch ID steel casing will be installed from ground surface to 145 feet bgs. A bentonite/cement grout will be used to fill the annular space.
3. Wireline coring barrels (NX rods) will be used to core 20 feet into the bedrock (165 feet bgs). The coring barrels will be retrieved and opened to collect the core sample.
4. Core samples will be photographed and described on test boring logs. Descriptions will follow the procedures outlined below.
5. The borehole will then be reamed to a 4-7/8-inch diameter. A 2-inch PVC casing (schedule 80) will be installed from ground surface to 165 feet bgs (20 feet into bedrock). The PVC casing will have a 5-foot long screen (0.010-inch slots). A bentonite seal with a minimum thickness of two feet will be installed directly above the sand pack. This

bentonite seal will be 3 feet in length. The remaining annular space will be filled with a bentonite and cement grout.

6. The temporary 10-inch I.D. steel casing will be removed and the well will be completed with an aboveground well protector and a locking cap.
7. Well development or purging may be necessary before collecting groundwater samples from the cased/screened hole in the bedrock. The procedures for both well development and well purging are presented below.
8. Water level measurements will then be collected, prior to sampling the bedrock groundwater. The procedure for measuring water levels is also presented below.
9. The bedrock groundwater sample collection method is presented after the procedure for water level measurements.

#### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

#### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

#### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

#### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

#### Description of Rock Samples

As mentioned earlier in this section, the rock core will be evaluated via photographs and petrographic thin sections. The geologists and geotechnical engineers will write their description of rock samples with a consistent format. A detailed order and presentation of selection of data are presented in Appendix J.

#### Groundwater Flow Direction (water levels)

Water levels will be measured quarterly for one year in the bedrock well and used to prepare water-level elevation maps. These will show seasonal changes in groundwater level and flow direction. Water level measurements will be conducted according to the same protocol outlined in Appendix I.

#### Groundwater Flow Rate (slug tests)

#### Rationale

Falling and rising head slug tests will be performed on the bedrock well, using a slug of known volume and in-well, short-time interval, automatic water-level recorders. With the falling-head and rising-head slug test data, aquifer hydraulic conductivity will be calculated for the well. Measured groundwater gradients and calculated aquifer hydraulic conductivities will be used to determine groundwater flow rates.

#### Field Procedure

Appendix K presents the field protocols for the completion of *in situ* hydraulic conductivity (slug) tests.

Slug test data will be downloaded from the data logger each day. The data will be reviewed for errors. If necessary, a slug test will be re-conducted.

### 5.2.3 Soil

#### 5.2.3.1 Surface Soil Samples

#### Rationale

Four surface soil samples (0 to 0.5 feet) will be collected at this disposal site. These samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment and the Ecological Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the surface soil sampling is presented in Table 6.

Figure 5 presents approximate soil sample locations in Site P.

#### Field Procedure

Surface soil samples will be discrete. A discrete sample represents a single location in the soil column. The soil samples will be collected from the Geoprobe® borings.

Appendix C presents the standard operating procedure for waste and soil sample collection.

### 5.2.3.2 Subsurface Soil Samples

#### Rationale

Four subsurface soil samples (0.5 to 6 feet) will be collected at each disposal site. As with the surface soil samples, the subsurface samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the subsurface soil sampling is presented in Table 7.

Figure 5 presents approximate soil sample locations for Site P.

#### Field Procedure

The four soil samples collected at this site will be collected at the location of each waste sample boring. The subsurface soil samples will be collected in the same manner as the waste samples.

Appendix C presents the standard operating procedure for waste and soil sample collection.

### 5.2.4 Air

### 5.2.4.1 Rationale

Two upwind and two downwind ambient air samples will be collected to determine the tendency of site constituents to enter the atmosphere and local wind patterns. Air sampling data will be used in the Human Health Risk Assessment and the Ecological Risk Assessment. Samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and dioxin.

Twenty-four hour cumulative duration sorbent tube/PUF/PM2.5 samples will be collected over a 1-day period, using the sampling protocols provided in Appendix L. Two upwind and two downwind samplers will be installed at the site during weather likely to produce emissions (e.g. hot and dry conditions in August). Sampling locations will be selected in the field with the concurrence of USEPA Region V or his designee. Sorbent tube samplers will be used for VOC data collection. Polyurethane foam (PUF) samplers will be used for SVOC, PCB, pesticide, herbicide, and dioxin data collection. PM2.5 samplers will be used for metal data collection

Ambient air sample collection is required to measure airborne levels of contaminants that may be evolving from the site. A 24-hour sample duration is required to average the air emission differences that may occur from the day time to night time cycle from on-site and off-site conditions and activities. Also, air sample collection locations need to be positioned on the site to collect up wind and down wind samples for differentiation of constituents originating from the surrounding area and those originating from the site. The sample protocol will collect site samples over a 1-day time period on a warm, dry day.

The level of detection for SVOCs required by USEPA Region V needs to consider sensitivity and selectivity to analyze complex samples. Based on this need, the analytical method of choice is gas chromatography coupled with mass spectrometry (GC/MS) for detection. Based on the GC/MS analytical method and its sensitivity level, the air sample volume needs to exceed 325 standard cubic feet. This enables the collection of a sufficient quantity of SVOCs to meet the level of detection required by USEPA Region V.

The sample method to meet the above requirements for SVOC measurement is USEPA Method TO-13, as identified in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (June 1988). This method will use a Graseby/General Metal Works, Inc. high volume air sampling unit or equivalent for sample collection. Sample collection will consist of drawing an ambient air sample at a high volume flow rate through a PUF collection media over a 24-hour time period. The samples will be submitted for analysis of the TO-13 list of SVOCs. Method TO-1 will be used to analyze VOCs. Method TO-13 will be used for pesticides, herbicides, and PCBs. Method TO-9 will analyze for dioxins.

Table 8 is a sample and analysis summary of this activity.

#### 5.2.4.2 Field Procedure

The following procedure will be used for ambient air samples:

- Place the sorbent tube samplers, PUF samplers, and PM2.5 samplers at upwind and downwind locations.
- Locate sampling positions in an unobstructed area, at least two meters from any obstacle to air flow. Sample locations will be selected in the field with the concurrence of the USEPA Region V, or its designee.
- No local power supply is readily available at the sites. Therefore, gasoline- or diesel-powered generators will be positioned at downwind locations from the sample collection positions. They will supply the electricity for the samplers.
- Record wind direction and velocity readings.
- Follow sample collection protocols identified in methods TO-1, TO-4, TO-13, and TO-9 (Appendix C) for sample preparation, calibration, collection, laboratory preparation and shipment, and calculations. Sample data sheets are provided in Appendix L.

### Treatability Tests

#### Rationale

The AOC requires that the SSP present a pilot test program for any treatment technologies lacking sufficient information on implementability and effectiveness. Data gaps exist for off-site incineration, off-site disposal, and on-site thermal desorption for the waste and on-site and off-site physical/chemical treatment, and off-site biological treatment for leachate.

A total of five composite waste samples (one for each site) will be collected for waste treatability testing and sent to appropriate facilities operators for waste profiling, material handling characterization and evaluation of the feasibility of disposing of the waste material by off-site incineration, off-site disposal, and on-site thermal desorption. In addition, five composite leachate samples (one for each site) will be collected for treatability testing to determine if the leachate can be discharged directly to American Bottoms POTW without resulting in pass through and/or interference.

One sample will be collected from each waste disposal area for waste treatability testing. The sample will be made from aliquots collected from the four waste characterization borings installed at each disposal area. One sample will be collected for the leachate treatability testing from each of the five-leachate sampling wells.

**Sample Collection**

The five composite waste samples that will be collected for treatability testing will be retained from the four-waste/soil borings that will be advanced at each waste disposal area. All of the material recovered from the Geoprobe® samples that are not needed for the other chemical analyses will be composited in 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facilities.

The leachate sample that will be collected for treatability testing will be collected during leachate sampling activities. An equal amount of leachate will be removed, via bailer or pump, from each of the five-leachate monitoring wells and placed in separate 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facility.

## 5.3 SITE Q

Because of the larger size and limited extent of previous investigation data for this site, Site Q will be partitioned into a northern and southern half, and each will be investigated using similar investigative programs as discussed below. In essence, the investigative program has been doubled for Site Q as compared to the other four sites. In addition, for these same reasons, a field screening program utilizing on-site analysis of soil samples for VOCs and SVOCs by GC/MS and metals by XRF will be employed at Site Q.

### 5.3.1 Waste Characterization

#### 5.3.1.1 Delineation of Source Area Boundaries – Test Trenches

**Rationale**

Historical air photos will be obtained for this site. These photos will be used to define the areal extent of the site over time and to determine the boundaries of the waste disposal area. Boundaries of the site on each photo will be observed. To define the maximum extent of fill, the tracings for the site will be overlain and a line will be drawn around the outside limit of the composite waste disposal area boundary. Results of the historical air photo analysis will be used to prepare a map for the site, showing disposal area boundaries. If stereoscopic evaluation of historical air photographs allows identification of the deepest portion of a waste disposal area, one or more of the eight waste characterization borings discussed below will be done at that location.

The triangular portion of property, which is currently excluded from the site boundaries (adjacent to the river), will also be assessed during the historical aerial photography review. If this analyses indicates potential waste disposal activities have occurred on this piece of property, the soil gas survey and magnetometer survey will be executed on this area as well. If these efforts indicate elevated soil gas levels or magnetic anomalies, the full investigation program of surface soil, subsurface soil,, waste, leachate well, alluvial and bedrock aquifer sampling will be applied to this area.

Test trenches will be used to confirm the boundaries of the waste disposal area identified through air photo analysis. One trench will be installed on each side of the waste disposal area for both the northern and southern half. Thus, there will be a total of eight trenches for the site. The eight trenches will be located at the midpoint of the longest sides of the defined site boundary. A GPS system will be used to document the locations on aerial site maps. Test trenches will start outside the defined boundary of the disposal area and move toward the defined boundary. When fill materials are encountered, the disposal area boundary will be compared to those identified in the air photo analysis and trenching at that location will then be terminated.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. Intact drums will be removed, provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums due to the inherent danger in such activities. Test trench locations will be determined using a GPS system. The trench locations will be recorded for future reference, in the event drum removal is appropriate. The drum removal contractor, in accordance with the requirements of 29 CFR 1910.120(j) will handle drums recovered during trenching activities. Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials. The absorbent, solid waste, and contaminated soil will be placed in bulk containers. The over-packed drums and these bulk containers will be temporarily stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums and wastes will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

Trenching locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

### Field Procedure

All trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow Occupational Safety and Health Administration (OSHA) rules for excavations.

Locations of test trenches for boundary confirmation of Site Q are shown on Figure 7. A "competent" person, as defined in 29 CFR 1976.650, will observe the trenching activities and will have authorization to take corrective measures to respond to unsanitary, hazardous, or dangerous conditions to workers. A track-mounted hoe with an extended arm will be used for excavation. A photoionization detector (PID), combustible gas monitor (CGM), and a real-time aerosol monitor (RAM) will be used on a continuous basis to monitor the test trenches for hazardous conditions.

Trenching activities will begin outside the site boundary and move in towards the boundary. The trenching will extend vertically to a maximum depth of 40 ft bgs or to groundwater, whichever is encountered first. No accommodations will be made to dewater test trenches or manage groundwater during excavation activities in order to minimize the generation of investigation-derived wastes. The trenching will continue until waste material is encountered. Should waste materials be encountered initially, the trenching activities will proceed out and away from the boundary until native soils are encountered. Where native soils are encountered, the excavation will proceed to greater depth up to a maximum of 40 ft below grade, where possible. Should waste materials be encountered again within the test trench, this procedure will be repeated until no waste materials are encountered within the test trench. The location where no additional waste materials are encountered within the test trench will be designated as the extent of the site boundary for that location.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic, having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. The gross contamination will be removed from the excavator bucket with a shovel and/or potable water source prior to handling the cover material. Decontamination debris will be placed into the excavation trench prior to placement of cover material. Handling of investigation-derived wastes from these activities is discussed in Section 9.

Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

The location of the test trenches will be illustrated on a plan of the site. Digital photographs will be taken of the test trenches, the test trench walls, and any waste materials excavated. The number and location of each photograph will be identified on the field log for each test trench.

### 5.3.1.2 Soil Gas Surveys

#### Rationale

A soil gas contractor will perform a soil gas survey at Site Q. A shallow soil probe (5 feet) and on-site analysis of collected VOC vapors with a GC will be used in this survey. Soil gas samples will be collected at the center points of a 200 by 200 ft grid, superimposed on the disposal area. The soil gas survey sampling grid for Site Q is displayed in Figure 8.

If detectable concentrations of Total VOCs are found in the soil gas samples at the disposal area boundary, the survey will be extended beyond that boundary. If extended beyond the site boundary, soil gas samples will be collected at 100-foot intervals (0, 100, and 200 feet from the edge of the disposal area) along as many as four 200-foot long transects. Each transect will run perpendicular to the relevant sides of the disposal area. If VOCs are detected in soil gas at this site, up to twelve additional soil gas samples may be collected.

If twelve additional samples are not adequate to define the extent of VOC-containing soils in the disposal area, additional soil gas samples will be collected at 100-foot intervals along the appropriate transects until the limits of the impacted fill are determined. If soil gas surveys need to extend into areas for which there are no property access agreements, soil gas sampling will be suspended until access is obtained.

Sampling locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

Table 2 is a sample and analysis summary for this activity.

#### Field Procedure

Direct push technology will be used to advance a retractable point holder to 5.5 feet below existing grade. The rods will then be pulled back to approximately 5 feet below existing grade to disengage the retractable point, therefore, exposing the sampling mechanism. Polyethylene tubing (0.125-inch diameter) will be lowered into the rods. The upper end of the polyethylene tubing will be connected to a 4-inch section of silicone tubing. This will then be attached to a section of polyethylene tubing coming from an active vacuum system and a vacuum will be placed in the tubing. A 60cc sample of soil gas will be withdrawn from the silicone tubing using a 60cc disposable syringe with a stainless steel needle. The sample will then be directly injected into the on-site GC. The GC will provide a report of the total VOC concentrations.

Sample tubing will be removed from the probe and disposed. Probing rods and sampling equipment will be removed from the boring. The probe boring will be filled with bentonite, to just bgs. The bentonite will be hydrated with potable water and the surface will be restored to its original condition. An SOP for the field GC is contained in Appendix A.

### 5.3.1.3 Field Screening for Soil Samples

#### Rationale

The objective of this effort will be to determine if areas of elevated VOC, SVOC, or metals concentrations exist at this site using a grid-based sampling approach. This data will be used to help identify sampling locations for the soil, waste, and leachate sampling efforts. A mobile laboratory contractor will perform a soil screening survey at Site Q. A shallow soil probe and on-site analysis of soil samples for VOCs and SVOCs by GC/MS and metals by XRF will be used in this survey. Soil samples will be collected at the center points of a 200 by 200 ft grid, superimposed on the disposal area. The soil screening survey sampling grid for Site Q is displayed in Figure 8.

Sampling locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

#### Field Procedure

Direct push technology (Geoprobe®) will be used to advance a shallow boring to 5.5 feet below exiting grade. The Geoprobe® will hydraulically drive a stainless steel, acetate-lined Macrobore® sampler (2-inch diameter by 4-foot length) to the desired sample depths. Between each sample collection, the sampler will be retrieved to the surface and samples removed from the disposable acetate liner within the sampler. These samples will be properly labeled and transported to the mobile field laboratory for analysis. VOC and SVOC concentrations will be determined by GC/MS methodology, and concentrations of the RCRA eight metals will be determined by XRF methodology. Upon completion, the probe boring will be filled with bentonite to just below ground surface. The bentonite will be hydrated with potable water and the surface will be restored to its original condition. An SOP for the XRF and field GC/MS is contained in Appendix A.

### 5.3.1.4 Waste Samples

#### Rationale

Eight borings will be advanced at this site to characterize the waste materials present. Continuous samples will be collected from grade to two feet below the bottom of the waste material, which is estimated to be a maximum of 40 feet below grade. If wastes are encountered at depths greater than 40 feet bgs (bgs), the boring will continue until the bottom of the waste is encountered. Scaled, color digital photographs will be taken of each waste sample to provide a record of materials present in the disposal area.

One composite waste sample will be collected at each boring location (8 total composite waste samples), and analyzed for SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. In addition, a portion of the composite waste sample from above the water table will be extracted using TCLP procedures and analyzed for this same suite of analytes. Visual observations and PID readings will be used to identify whether or not waste is present in a continuous boring sample. If waste is present in a sample, it will be removed, segregated, temporarily stored and used at the completion of the boring to prepare a composite waste sample. Since VOC samples cannot be composited without losing volatiles, the waste with the highest PID readings will be used for VOC analysis.

Existing information (e.g., the 1998 Ecology and Environment report and the results of the aerial photograph analysis, soil gas surveys, field screening of soil samples by GC/MS and XRF methodology and magnetometer surveys conducted as part of the SSP) will be used to select boring locations. Approximate waste characterization boring locations for Site Q are shown on Figure 7. Additional waste characterization borings may be required by USEPA Region V as a result of variability in waste characteristics observed during the waste characterization boring program.

Table 3 is a sample and analysis summary for waste samples to be collected.

**Field Procedure**

Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depths. Continuous soil samples will be collected from grade to 2 feet below the bottom of the waste material (estimated to be 40 feet bgs). Between each sample collection, the sampler will be retrieved to the surface and the samples removed from the disposable acetate liner within the sampler.

One composite waste sample will be collected from each boring. Each sample will be visually observed and monitored with PID readings, to determine whether waste is present. If waste is present in a sample, it will be removed, segregated, temporarily stored, and used at the completion of the boring to prepare a composite waste sample. The sample exhibiting the highest PID reading at each of the four boring locations within this site will be used for VOC analysis. A 5-gram EnCore® sampler will be used to collect VOC samples.

Refer to Appendix C for detailed soil/waste sampling procedures.

Descriptive logs of each boring will be prepared as described in Appendix E. The waste borings generated at each of the five sites will also be used for surface and subsurface soil sample collection. All borings will be grouted to the surface, following retrieval of both the waste and soil samples.

### Logging Unconsolidated Samples

The geologist logging samples will be responsible to interpret the samples following standard and acceptable methods. The geologist implementing this work plan will have training and experience logging boring samples. Soil will be logged according to applicable ASTM standards. As appropriate, ASTM standards will be used to log waste materials. Appendix E presents detailed instructions for logging soil and waste samples.

### 5.3.1.5 Buried Drum and Tank Identification

### Magnetometer Survey

### Rationale

A magnetometer survey will be conducted at this site to identify anomalies indicative of drum disposal or buried tanks. Magnetometer measurements will be made at locations determined by superimposing a 50-foot by 50-foot grid on the disposal area.

Surface geophysical surveys, which map the distribution of the strength of the earth's magnetic field, have been proven useful in evaluating shallow and deep subsurface conditions at environmental sites. These geophysical surveys have been used to successfully locate buried objects containing magnetically susceptible materials (e.g., iron and nickel metals). The ability of geophysical equipment to locate buried objects is, for the most part, dependent on:

- The strength and orientation of the magnetic anomaly associated with the buried objects
- The strength and natural variation of the earth's magnetic field in response to local geology
- The influence of man-made surface features (such as power lines, buried utilities, vehicles, electric motors, etc.) which may interfere with the collection of data.

By comparing the known surface and geological conditions to a magnetic survey map that includes mapped surface feature interferences, and understanding possible geologic background effects, it is possible to identify the location of suspicious subsurface features which may represent buried tanks or drum disposal areas.

### Method

A geophysical survey of the site's magnetic field will be completed utilizing a field magnetometer and electromagnetic induction. The field magnetometer measures the strength of the site's magnetic field regardless of the orientation of the magnetic lines of force. During the performance of the geophysical survey, data for the preparation of a field map will be collected. The final product of this survey will include a description of the site, contour maps, and an explanation of how the survey was conducted.

A correction for diurnal and micropulsation time variations is not necessary because the site and anticipated anomalies are relatively small in area (less than 1 square mile), and subsurface anomalies from buried objects of interest should be relatively large (greater than 100 gammas).

The map showing the distribution of magnetic field strength over the site will be compared with the observed field conditions (including the location of known interfering objects such as vehicles, overhead power lines, and surface debris). By comparison, those magnetic anomalies, which cannot be explained by, observed site conditions, will be presumed to be a result of buried subsurface material (e.g., drums, tanks, metal debris, etc.). The depth of detection for suspect objects (such as steel drums) may vary according to orientation, method of manufacture and condition, and numbers present. Steel drums, such as those suspected to be present at this site, may be detected to depths of 40 feet.

### Study Area

The area of the properties to be surveyed will be evaluated in the field. Magnetometer surveys will be conducted at a total of four sites (P, Q, R, and S) within Area 2. A general area for Site Q survey site has been delineated and provided on Figure 8 (Fill Area Location Map). Overall site dimensions for the survey sites will be adjusted based upon the findings of the source area boundary delineation activities discussed in Section 5.2.1.1.

### Field Procedure

The following field equipment and procedures will be employed during this geophysical investigation.

### Equipment

A Geometrics 858 Cesium or a Geometrics 856AX Total Field Magnetometer will be used to collect the field data. Field procedures and operation of the instruments will be in accordance with the recommended manufacturer's field procedure and application manual.

Calibrated field survey equipment consisting of marked survey line, tape rulers, highway danger cones, and marked wooden stakes will be utilized to establish measurement locations.

### Measurement Point/Grid Surveying

The established survey lines will be marked in the field using a premarked survey line to maintain straight and precise station locations. Profiles will be completed along a straight line with an unobstructed line of sight. The corners of each of the gridded areas will be marked with temporary corner stakes to permit the relocation of the measurement points within each site.

### Data Processing

Following completion of the field phase of investigation, the following data processing will be performed:

- Explanation of where and how the survey was performed
- Description of each of the four sites (P, Q, R, S) in terms of magnetic anomalies detected
- A contour map of these data will be produced showing the location of the measurement points and the corresponding magnetometer reading.

## Test Trenches

### Rationale

Test trenches will be installed at this site to confirm the presence of buried drums of tanks. Two test trenches will be installed at each site. The waste disposal areas within Area 2 were used for disposal of municipal and industrial waste as well as construction debris. Magnetic anomalies are likely to be numerous, intense, and widespread. If no location criteria other than the presence of a magnetic anomaly is used to determine whether or not a test trench is appropriate, disturbance of a significant portion of each disposal area is likely to result. Excessive trenching could result in unacceptable risks to the community, on-site workers and the environment.

For this reason, four selection criteria will be used to identify where to install each test trench. Test trenching will be done at the location of the largest magnetic anomaly that coincides with:

1. A soil gas concentration high,
2. Drum or tank disposal locations identified by historical air photo interpretation,
3. An area of high groundwater concentrations (greater than 10,000 ppb) as identified by the 1998 Ecology and Environment Data Report, and
4. Major magnetic anomalies reported in the 1988 Ecology and Environment "Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois".

Care will be taken not to place major emphasis on the comparison of historical groundwater concentrations and magnetic anomalies due to the extent of historical industrial groundwater pumping in the area.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. These will be removed, provided confined spaced entry is not needed to retrieve a drum. Trenches will not be entered to recover drums because of the danger inherent in such activities. Test trench locations will be determined using a GPS and recorded for future reference in the event drum removal is appropriate.

Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil, resulting from rupture of drums during removal, will be cleaned up by absorbing any liquid materials and placing the absorbent, solid waste, and contaminated soil in bulk containers. Over-packed drums and bulk solid and liquid containers will be stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the disposal area will be noted in the field log and photographed.

### Field Procedure

Anomaly test trench locations will be selected in the field based upon the parameters outlined in the Rationale section, and with the concurrence of the USEPA Region V or its designee.

To complete the anomaly test trench, a track-mounted or wheel-mounted hoe will be utilized. The depth to the top of buried anomalies is not expected to extend past 40 feet below grade; thus, a smaller piece of equipment may be utilized for these anomaly test trenches (in comparison to the trenches completed for delineation of the fill area boundaries). Trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching will follow OSHA rules for excavations. A PID, CGM, and a RAM will be used on a continuous basis to monitor the anomaly test trenches for hazardous conditions. The hoe operator will have a separate supplied-air system.

Anomaly test trenches will be advanced until evidence as to the source of the anomaly is found or to a maximum depth of 40 feet, where possible. Should groundwater infiltration and/or poor soil stability result in the inability to complete a test trench to 40 feet, the trenching will be terminated at that location. No accommodations will be made to de-water test trenches or manage groundwater during excavation activities, due to the need to minimize the generation of investigation-derived wastes.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events.

If intact drums are found during anomaly test trench completion, they will be removed, over-packed, and stored in an area to be designated in accordance with the requirements of 29 CFR 1910.120(j). For planning purposes, it is anticipated that up to ten over-packs will be necessary per site and that one day of anomaly test trenching will occur at each of the four sites. Handling of investigation-derived wastes from these activities is discussed in Section 9.

A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

#### 5.3.1.6 Leachate Samples

**Rationale**

A 2-inch diameter well, screened at the bottom of the fill material, will be installed in two of the eight waste characterization borings completed at this site. The purpose of these wells is to characterize leachate at the site. The wells will be sampled and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. The analytical methods are presented in Table 1.

**Field Procedure**

**Well Installation**

The depth and screened interval for the wells will be determined in accordance with the subsurface stratigraphy observed during Geoprobe® waste sampling activities. It is expected that the waste at the site extends to approximately 40 feet bgs. Unless observed conditions indicate otherwise, a screened interval of 10 feet will be used. The wells will be seated at the bottom of the waste. A 4-1/4 inch ID hollow-stem auger will be used to advance the boring to the bottom of the waste material. The wells will be constructed of two-inch diameter, schedule 40 PVC casing and 0.010-inch slotted schedule 40 PVC well screen. A sand pack, consisting of silica sand, will be installed from the bottom of the wells to two feet above the well screen. A bentonite seal with a minimum thickness of two feet will be installed directly above the sand pack. The remaining annular space will be filled with a bentonite and cement grout. The wells will be completed with an aboveground well protector and a locking cap.

Following installation of the leachate wells, the top of casing and ground surface will be surveyed to establish well and grade elevations and well location. Well installation details will be documented on a test boring log (Appendix D) and in the field notebook. The leachate wells will generally be installed according to the typical well construction diagrams and standard procedures presented in Appendix G.

Following completion of monitoring well construction activities, the water level will be allowed to stabilize and will then be gauged to determine groundwater elevation and the total volume of groundwater in the well. After the water level in the well has been determined, the well will be developed to remove the fines from the sand pack. The development will consist of pumping or bailing the well, following the protocol described later in this section.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 7 displays approximate leachate monitoring well location for Site Q. At least one of these wells will be located directly adjacent to the east pond.

**Well Development**

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

**Well Purging (if necessary)**

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

**Water Level Measurements**

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

**Groundwater Pre-Sampling and Well Sampling**

Appendix I presents the protocol for groundwater sampling activities.

### 5.3.2 Hydrogeology

#### 5.3.2.1 Alluvial Aquifer

**Horizontal Extent of Contaminant Migration**

**Rationale**

Groundwater samples will be collected in the alluvial aquifer downgradient of this waste disposal area. The purpose of this sampling is to define the extent of migration away from the source area and to provide information for the Human Health Risk Assessment.

Groundwater samples will be collected at six sampling stations located on the east property boundary of Site Q. Unfiltered groundwater samples will be collected every 10 feet from the water table to the bottom of the aquifer using push sampling technologies such as Geoprobe®, HydroPunch®, Microwell®, Waterloo Profiler® or equivalent low-flow sampling techniques. Aquifer saturated thickness is estimated to be approximately 120 feet with depth to water at 20 feet bgs and bottom of the aquifer at 140 feet bgs. All samples will be analyzed for VOCs and SVOCs. Additionally, unfiltered samples will be collected at 40 foot intervals (i.e., 20, 60, 100, and 140 foot bgs) and analyzed for pesticides, herbicides, PCBs, metals, and several geochemical parameters (presented in Table 1). Dioxin will be analyzed only at the two sampling stations closest to Site Q. For dioxin analysis, unfiltered groundwater samples will be collected at the top, middle, and bottom of the saturated zone (e.g., 20, 80, 140 feet bgs).

Experience at other sites indicates that push-sampling technologies such as Geoprobe® can reach depths of 60 feet. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe® sampler or equivalent sampling technology cannot penetrate to the required depth, Microwells® will be used to collect groundwater samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 feet can be achieved. If the required sampling depths cannot be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the alluvial aquifer groundwater sampling is presented in Table 4.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Area 2.

### Field Procedure

#### Establishment of Boreholes

##### Push Point

Using the hydraulic push system of a Geoprobe®, a 4-foot stainless steel sampler with a wire wrap (slot size of 0.004 inches) will be pushed to the desired sample depth. A bailer or ball and check valve will be sent down to the slotted portion of the sampler to collect the groundwater sample. The groundwater sample will be retrieved to the surface and placed in a sample container. The Geoprobe® will then drive the sampler to the next desired sample depth, by connecting clean sections of push rods to the Geoprobe®, and a second groundwater sample will be collected here. This process will be continued until all samples are collected.

### MicroWell®

It is anticipated the above sampling method will be used, as feasible. However based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered, which will stop the Geoprobe®. Should this occur, MicroWells® will be installed to use as the sample collection point. The MicroWells® will be hydraulically pushed to the appropriate depth, and the sampling procedure described above will be followed. Once the sample is collected, the MicroWell® will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced further in the same hole. This procedure will be repeated until all samples are collected.

Should MicroWell® installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which groundwater will flow. Once the sample is collected, the augers will be advanced further for collection at the next sample depth. This procedure will be repeated until all samples are collected within the borehole.

All Geoprobe®, MicroWell®, or Waterloo Profiler® holes will be sealed with grout from the bottom up and the surface will be returned to it's original condition after completion of sampling at each location. A PID, explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

### Groundwater Pre-Sampling and Borehole Sampling

Appendix I presents the protocol for groundwater sampling activities.

#### 5.3.2.2 Bedrock Groundwater

**Vertical Extent of Contaminant Migration**

**Rationale**

Two bedrock wells will be installed downgradient of this site. The purpose of the bedrock sampling is to determine the extent of organic and inorganic constituent vertical migration from the site Steel surface casing will be installed 5 feet into bedrock.

After installing the surface casing 5 feet into bedrock, the bedrock will be cored to a depth of 20 feet below the bottom of the casing. Cores will be digitally photographed in color against a scale and evaluated for porosity by examination and petrographic thin sections. One thin section will be made for each 2 feet of bedrock core. A 2-inch diameter, 5-foot-long screen and casing will be installed in the borehole. The screen will be filter-packed, sealed and grouted from 3 feet above the top of the filter-pack to grade. An unfiltered groundwater sample will be collected from the well following installation and development and will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the bedrock groundwater sampling is presented in Table 5.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Site Q.

**Field Procedure**

Mud rotary drilling methods will be used to drill the borehole to set the surface casing and to drill 5 feet into the top of bedrock Coring will then be accomplished using wireline coring barrels to generate a 2-inch thick minimum core. Coring will continue for 20 feet into the bedrock. The drilling and sampling procedure will be as follows:

1. A temporary 10-inch ID steel casing will be installed from ground surface to 10 feet bgs. A bentonite/cement grout will be used to fill the annular space.
2. A 8-3/4-inch ID tri-cone bit will then be used to drill down to 145 feet. A 5-inch ID steel casing will be installed from ground surface to 145 feet bgs. A bentonite/cement grout will be used to fill the annular space.

3. Wireline coring barrels (NX rods) will be used to core 20 feet into the bedrock (165 feet bgs). The coring barrels will be retrieved and opened to collect the core sample.
4. Core samples will be photographed and described on test boring logs. Descriptions will follow the procedures outlined below.
5. The borehole will then be reamed to a 4-7/8-inch diameter. A 2-inch PVC casing (schedule 80) will be installed from ground surface to 165 feet bgs (20 feet into bedrock). The PVC casing will have a 5-foot long screen (0.010-inch slots). A bentonite seal with a minimum thickness of two feet will be installed directly above the sand pack. This bentonite seal will be 3 feet in length. The remaining annular space will be filled with a bentonite and cement grout.
6. The temporary 10-inch I.D. steel casing will be removed and the well will be completed with an aboveground well protector and a locking cap.
7. Well development or purging may be necessary before collecting groundwater samples from the cased/screened hole in the bedrock. The procedures for both well development and well purging are presented below.
8. Water level measurements will then be collected, prior to sampling the bedrock groundwater. The procedure for measuring water levels is also presented below.
9. The bedrock groundwater sample collection method is presented after the procedure for water level measurements.

### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

### Description of Rock Samples

As mentioned earlier in this section, the rock core will be evaluated via photographs and petrographic thin sections. The geologists and geotechnical engineers will write their description of rock samples with a consistent format. A detailed order and presentation of selection of data are presented in Appendix J.

### Groundwater Flow Direction (water levels)

Water levels will be measured quarterly for one year in the bedrock well and used to prepare water-level elevation maps. These will show seasonal changes in groundwater level and flow direction. Water level measurements will be conducted according to the same protocol outlined in Appendix I.

### Groundwater Flow Rate (slug tests)

#### Rationale

Falling and rising head slug tests will be performed on the bedrock well, using a slug of known volume and in-well, short-time interval, automatic water-level recorders. With the falling-head and rising-head slug test data, aquifer hydraulic conductivity will be calculated for the well. Measured groundwater gradients and calculated aquifer hydraulic conductivities will be used to determine groundwater flow rates.

#### Field Procedure

Appendix K presents the field protocols for the completion of *in situ* hydraulic conductivity (slug) tests.

Slug test data will be downloaded from the data logger each day. The data will be reviewed for errors If necessary, a slug test will be re-conducted.

### 5.3.3 Soil

#### 5.3.3.1 Surface Soil Samples

**Rationale**

Eight surface soil samples (0 to 0.5 feet) will be collected at this disposal site. These samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment and the Ecological Risk Assessment. In addition, three surface soil samples will be collected along a transect line at 200 foot intervals in the field immediately south of Site Q to determine if chemicals of potential concern have been transported during overland flows. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the surface soil sampling is presented in Table 6.

Figure 7 presents approximate soil sample locations in Site Q.

**Field Procedure**

Surface soil samples will be discrete. A discrete sample represents a single location in the soil column. The soil samples will be collected from the Geoprobe® borings.

Appendix C presents the standard operating procedure for waste and soil sample collection.

#### 5.3.3.2 Subsurface Soil Samples

**Rationale**

Eight subsurface soil samples (0.5 to 6 feet) will be collected at each disposal site. As with the surface soil samples, the subsurface samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment. In addition, three subsurface soil samples will be collected along a transect line at 200 foot intervals in the field immediately south of Site Q to determine if chemicals of potential concern have been transported during overland flows. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the subsurface soil sampling is presented in Table 7.

Figure 7 presents approximate soil sample locations for Site Q.

### Field Procedure

The eight soil samples collected at this site will be collected at the location of each waste sample boring. The subsurface soil samples will be collected in the same manner as the waste samples.

Appendix C presents the standard operating procedure for waste and soil sample collection.

## 5.3.4 Air

### 5.3.4.1 Rationale

Four upwind and four downwind ambient air samples will be collected to determine the tendency of site constituents to enter the atmosphere and local wind patterns. Air sampling data will be used in the Human Health Risk Assessment and Ecological Risk Assessment. Samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and dioxin.

Twenty-four hour cumulative duration sorbent tube/PUF/PM2.5-samples will be collected over a 1-day period, using the sampling protocols provided in Appendix L. Four upwind and four downwind samplers will be installed at the site during weather likely to produce emissions (e.g. hot and dry conditions in August). Sampling locations will be selected in the field with the concurrence of USEPA Region V or his designee. Sorbent tube samplers will be used for VOC data collection. Polyurethane foam (PUF) samplers will be used for SVOC, PCB, pesticide, herbicide, and dioxin data collection. PM2.5 samplers will be used for metal data collection

Ambient air sample collection is required to measure airborne levels of contaminants that may be evolving from the site. A 24-hour sample duration is required to average the air emission differences that may occur from the day time to night time cycle from on-site and off-site conditions and activities. Also, air sample collection locations need to be positioned on the site to collect up wind and down wind samples for differentiation of constituents originating from the surrounding area and those originating from the site. The sample protocol will collect site samples over a 1-day time period on a warm, dry day.

The level of detection for SVOCs required by USEPA Region V needs to consider sensitivity and selectivity to analyze complex samples. Based on this need, the analytical method of choice is gas chromatography coupled with mass spectrometry (GC/MS) for detection. Based on the GC/MS analytical method and its sensitivity level, the air sample volume needs to exceed 325 standard cubic feet. This enables the collection of a sufficient quantity of SVOCs to meet the level of detection required by USEPA Region V.

The sample method to meet the above requirements for SVOC measurement is USEPA Method TO-13, as identified in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (June 1988). This method will use a Graseby/General Metal Works, Inc high volume air sampling unit or equivalent for sample collection. Sample collection will consist of drawing an ambient air sample at a high volume flow rate through a PUF collection media over a 24-hour time period. The samples will be submitted for analysis of the TO-13 list of SVOCs. Method TO-1 will be used to analyze VOCs. Method TO-13 will be used for pesticides, herbicides, and PCBs. Method TO-9 will analyze for dioxins.

Table 8 is a sample and analysis summary of this activity.

### 5.3.4.2 Field Procedure

The following procedure will be used for ambient air samples:

- Place the sorbent tube samplers, PUF samplers, and PM2.5 samplers at upwind and downwind locations.
- Locate sampling positions in an unobstructed area, at least two meters from any obstacle to air flow. Sample locations will be selected in the field with the concurrence of the USEPA Region V, or its designee.
- No local power supply is readily available at the sites. Therefore, gasoline- or diesel-powered generators will be positioned at downwind locations from the sample collection positions. They will supply the electricity for the samplers.
- Record wind direction and velocity readings.
- Follow sample collection protocols identified in methods TO-1, TO-13, and TO-9 (Appendix C) for sample preparation, calibration, collection, laboratory preparation and shipment, and calculations. Sample data sheets are provided in Appendix L.

### 5.3.5 Stormwater Runoff

#### 5.3.5.1 Rationale

Two stormwater runoff grab samples will be collected at downgradient locations within this site, in an effort to characterize runoff from the site during storm events. Samples will be collected within the primary drainage route, leading from the site to the Mississippi River. This sampling will be conducted at Sites Q and R because they are on the wet side of the floodwall and levee. The other three sites (O, P, and S) are on the dry side of the floodwall and levee and therefore have no drainage route to the Mississippi River. Samples will be collected during three storms to determine variability of constituent concentrations in site runoff. A first flush sample will be collected utilizing an automated sampling device. A first flush sample is one collected at the very beginning of a storm event (e.g., as the first flow comes through). Collection of a first flush sample insures that any contamination on the ground surface prior to the storm event will be collected before it has the opportunity to wash away. Storm water samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

The analytical methods are presented in Table 1. Table 9 presents a sample and analysis summary for storm water runoff samples to be collected.

The Site Q sample location for stormwater runoff is shown on Figure 7.

#### 5.3.5.2 Field Procedure

Refer to Appendix M for the standard method of storm water sample collection.

The following method will be used for collection of storm water samples:

1. Identify the primary storm water drainage route, running from the site to the Mississippi River. Figure 7 of this FSP presents approximate storm water sampling locations for Site Q.
2. Collect the sample during a rainfall, which results in a discharge. A storm water sample will be collected during three separate storm events (for a total of three samples per site).
3. Set up appropriate parameters on automated sampler.
4. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.

5. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection, except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.
6. Put on a clean pair of disposable gloves.
7. Set sampler to fill sample containers for the VOC sample, prior to filling other sample containers. Verify that there is no air in the sealed sampled container.
8. Transfer sample to appropriate containers for shipment to laboratory.
9. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.
10. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.
11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.
12. Record the physical appearance of the storm water observed during sampling in the field notebook.

### Treatability Tests

#### Rationale

The AOC requires that the SSP present a pilot test program for any treatment technologies lacking sufficient information on implementability and effectiveness. Data gaps exist for off-site incineration, off-site disposal, and on-site thermal desorption for the waste and on-site and off-site physical/chemical treatment, and off-site biological treatment for leachate.

A total of five composite waste samples (one for each site) will be collected for waste treatability testing and sent to appropriate facilities operators for waste profiling, material handling characterization and evaluation of the feasibility of disposing of the waste material by off-site incineration, off-site disposal, and on-site thermal desorption. In addition, five composite leachate samples (one from each site) will be collected for treatability testing to determine if the leachate can be discharged directly to American Bottoms POTW without resulting in pass through and/or interference.

One sample will be collected from each waste disposal area for waste treatability testing. The sample will be made from aliquots collected from the four waste characterization borings installed at each disposal area. One sample will be collected for the leachate treatability testing from each of the five-leachate sampling wells.

#### Sample Collection

The five composite waste samples that will be collected for treatability testing will be retained from the four-waste/soil borings that will be advanced at each waste disposal area. All of the material recovered from the Geoprobe® samples that are not needed for the other chemical analyses will be composited in 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facilities.

The leachate sample that will be collected for treatability testing will be collected during leachate sampling activities. An equal amount of leachate will be removed, via bailer or pump, from each of the five-leachate monitoring wells and placed in separate 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facility.

### 5.3.6 Seep Investigation

#### 5.3.6.1 Rationale

A visual reconnaissance survey will be undertaken along the riverbank adjacent to Site Q during the low flow periods to assess the presence of seeps and their impacts, if any, on the Mississippi River. The locations of any seeps observed will be located with a GPS, photographed, and if sufficient quantity is present, sampled for VOC, SVOC, PCBs, dioxin, herbicide, pesticide, and metals. Where appropriate, several smaller seeps in close proximity to each other may be sampled as a single location. If sample volume is limited, sample containers will be prioritized and filled in order of analytical parameters as presented above.

The analytical methods are presented in Table 1.

#### 5.3.6.2 Field Procedure

Refer to Appendix M for the standard method of seep water sample collection.

The following method will be used for collection of seep water samples:

1. Identify the seep location(s) along the riverbank and note location.
2. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.
3. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection, except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.
4. Grab sampling procedures and preservation of the collected seep water samples will follow the methods described in the current edition of "Standard Methods for the Examination of Water and Wastewater" (published by the American Public Health Association).
5. Put on a clean pair of disposable gloves.
6. Use a dipping utensil to retrieve a sample.
7. Fill sample containers for the VOC sample, prior to filling other sample containers. Verify that there is no air in the sealed sampled container.
8. Fill remaining sample containers.
9. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.
10. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.
11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.

12. Record the physical appearance of the storm water observed during sampling in the field notebook.

## 5.4 SITE R

### 5.4.1 Waste Characterization

#### 5.4.1.1 Delineation of Source Area Boundaries – Test Trenches

**Rationale**

Historical air photos will be obtained for this site. These photos will be used to define the areal extent of the site over time and to determine the boundaries of the waste disposal area. Boundaries of the site on each photo will be observed. To define the maximum extent of fill, the tracings for the site will be overlain and a line will be drawn around the outside limit of the composite waste disposal area boundary. Results of the historical air photo analysis will be used to prepare a map for the site, showing disposal area boundaries. If stereoscopic evaluation of historical air photographs allows identification of the deepest portion of a waste disposal area, one of the four waste characterization borings discussed below will be done at that location.

Test trenches will be used to confirm the boundaries of the waste disposal area identified through air photo analysis. One trench will be installed on each side of the waste disposal area. Thus, there will be a total of four trenches for the site. The four trenches will be located at the midpoint of the four longest sides of the defined site boundary. A GPS system will be used to document the locations on aerial site maps. Test trenches will start outside the defined boundary of the disposal area and move toward the defined boundary. When fill materials are encountered, the disposal area boundary will be compared to those identified in the air photo analysis and trenching at that location will then be terminated.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. Intact drums will be removed, provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums due to the inherent danger in such activities. Test trench locations will be determined using a GPS system. The trench locations will be recorded for future reference, in the event drum removal is appropriate. The drum removal contractor, in accordance with the requirements of 29 CFR 1910.120(j) will handle drums recovered during trenching activities. Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials. The absorbent, solid waste, and contaminated soil will be placed in bulk containers. The over-packed drums and these bulk containers will be temporarily stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums and wastes will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

Trenching locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

### Field Procedure

All trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow Occupational Safety and Health Administration (OSHA) rules for excavations.

Locations of test trenches for boundary confirmation of Site R are shown on Figure 9. A "competent" person, as defined in 29 CFR 1976.650, will observe the trenching activities and will have authorization to take corrective measures to respond to unsanitary, hazardous, or dangerous conditions to workers. A track-mounted hoe with an extended arm will be used for excavation A photoionization detector (PID), combustible gas monitor (CGM), and a real-time aerosol monitor (RAM) will be used on a continuous basis to monitor the test trenches for hazardous conditions.

Trenching activities will begin outside the site boundary and move in towards the boundary. The trenching will extend vertically to a maximum depth of 40 ft bgs or to groundwater, whichever is encountered first. No accommodations will be made to dewater test trenches or manage groundwater during excavation activities in order to minimize the generation of investigation-derived wastes. The trenching will continue until waste material is encountered. Should waste materials be encountered initially, the trenching activities will proceed out and away from the boundary until native soils are encountered. Where native soils are encountered, the excavation will proceed to greater depth up to a maximum of 40 ft below grade, where possible. Should waste materials be encountered again within the test trench, this procedure will be repeated until no waste materials are encountered within the test trench. The location where no additional waste materials are encountered within the test trench will be designated as the extent of the site boundary for that location.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic, having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. The gross contamination will be removed from the excavator bucket with a shovel and/or potable water source prior to handling the cover material. Decontamination debris will be placed into the excavation trench prior to placement of cover material. Handling of investigation-derived wastes from these activities is discussed in Section 9.

Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

The location of the test trenches will be illustrated on a plan of the site. Digital photographs will be taken of the test trenches, the test trench walls, and any waste materials excavated. The number and location of each photograph will be identified on the field log for each test trench.

#### 5.4.1.2 Soil Gas Surveys

**Rationale**

A soil gas contractor will perform a soil gas survey at Site R. A shallow soil probe (5 feet) and on-site analysis of collected VOC vapors with a GC will be used in this survey. Soil gas samples will be collected at the center points of a 200 by 200 ft grid, superimposed on the disposal area, resulting in approximately four sampling locations. The soil gas survey sampling grid for Site R is displayed in Figure 10.

If detectable concentrations of Total VOCs are found in the soil gas samples at the disposal area boundary, the survey will be extended beyond that boundary. If extended beyond the boundary, soil gas samples will be collected at 100-foot intervals (0, 100, and 200 feet from the edge of the disposal area) along as many as four 200-foot long transects. Each transect will run perpendicular to the relevant sides of the disposal area. If VOCs are detected in soil gas at this site, up to twelve additional soil gas samples may be collected.

If twelve additional samples are not adequate to define the extent of VOC-containing soils in the disposal area, additional soil gas samples will be collected at 100-foot intervals along the appropriate transects until the limits of the impacted fill are determined. If soil gas surveys need to extend into areas for which there are no property access agreements, soil gas sampling will be suspended until access is obtained.

Sampling locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

Table 2 is a sample and analysis summary for this activity.

#### Field Procedure

Direct push technology will be used to advance a retractable point holder to 5.5 feet below existing grade. The rods will then be pulled back to approximately 5 feet below existing grade to disengage the retractable point, therefore, exposing the sampling mechanism. Polyethylene tubing (0.125-inch diameter) will be lowered into the rods. The upper end of the polyethylene tubing will be connected to a 4-inch section of silicone tubing. This will then be attached to a section of polyethylene tubing coming from an active vacuum system and a vacuum will be placed in the tubing. A 60cc sample of soil gas will be withdrawn from the silicone tubing using a 60cc disposable syringe with a stainless steel needle. The sample will then be directly injected into the on-site GC. The GC will provide a report of the total VOC concentrations.

Sample tubing will be removed from the probe and disposed. Probing rods and sampling equipment will be removed from the boring. The probe boring will be filled with bentonite, to just bgs. The bentonite will be hydrated with potable water and the surface will be restored to its original condition. An SOP for the field GC is contained in Appendix A.

#### 5.4.1.3 Waste Samples

**Rationale**

Four borings will be advanced at this site to characterize the waste materials present. Continuous samples will be collected from grade to two feet below the bottom of the waste material, which is estimated to be a maximum of 40 feet below grade. If wastes are encountered at depths greater than 40 feet bgs (bgs), the boring will continue until the bottom of the waste is encountered. Scaled, color digital photographs will be taken of each waste sample to provide a record of materials present in the disposal area.

One composite waste sample will be collected at each boring location (4 total composite waste samples), and analyzed for SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. In addition, a portion of the composite waste sample from above the water table will be extracted using TCLP procedures and analyzed for this same suite of analytes. Visual observations and PID readings will be used to identify whether or not waste is present in a continuous boring sample. If waste is present in a sample, it will be removed, segregated, temporarily stored and used at the completion of the soil boring to prepare a composite waste sample. Since VOC samples cannot be composited without losing volatiles, the waste with the highest PID readings will be used for VOC analysis.

Existing information (e.g., the 1998 Ecology and Environment report and the results of the aerial photograph analysis, soil gas surveys, and magnetometer surveys conducted as part of the SSP) will be used to select boring locations. Approximate waste characterization boring locations for Site R are shown on Figure 9. Additional waste characterization borings may be required by USEPA Region V as a result of variability in waste characteristics observed during the waste characterization boring program.

Table 3 is a sample and analysis summary for waste samples to be collected.

**Field Procedure**

Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depths. Continuous samples will be collected from grade to 2 feet below the bottom of the waste material (estimated to be 40 feet bgs). Between each sample collection, the sampler will be retrieved to the surface and the samples removed from the disposable acetate liner within the sampler.

One composite waste sample will be collected from each boring. Each sample will be visually observed and monitored with PID readings, to determine whether waste is present. If waste is present in a sample, it will be removed, segregated, temporarily stored, and used at the completion of the soil boring to prepare a composite waste sample. The sample exhibiting the highest PID reading at each of the four boring locations within this site will be used for VOC analysis. A 5-gram EnCore® sampler will be used to collect VOC samples.

Refer to Appendix C for detailed soil/waste sampling procedures.

Descriptive logs of each boring will be prepared as described in Appendix E. The four waste borings generated at each of the five sites will also be used for surface and subsurface soil sample collection. All borings will be grouted to the surface, following retrieval of both the waste and soil samples.

**Logging Unconsolidated Samples**

The geologist logging samples will be responsible to interpret the samples following standard and acceptable methods. The geologist implementing this work plan will have training and experience logging boring samples. Soil will be logged according to applicable ASTM standards. As appropriate, ASTM standards will be used to log waste materials. Appendix E presents detailed instructions for logging soil and waste samples.

#### 5.4.1.4 Buried Drum and Tank Identification

**Magnetometer Survey**

**Rationale**

A magnetometer survey will be conducted at this site to identify anomalies indicative of drum disposal or buried tanks. Magnetometer measurements will be made at locations determined by superimposing a 50-foot by 50-foot grid on the disposal area.

Surface geophysical surveys, which map the distribution of the strength of the earth's magnetic field, have been proven useful in evaluating shallow and deep subsurface conditions at environmental sites. These geophysical surveys have been used to successfully locate buried objects containing magnetically susceptible materials (e.g., iron and nickel metals). The ability of geophysical equipment to locate buried objects is, for the most part, dependent on:

- The strength and orientation of the magnetic anomaly associated with the buried objects
- The strength and natural variation of the earth's magnetic field in response to local geology
- The influence of man-made surface features (such as power lines, buried utilities, vehicles, electric motors, etc.) which may interfere with the collection of data.

By comparing the known surface and geological conditions to a magnetic survey map that includes mapped surface feature interferences, and understanding possible geologic background effects, it is possible to identify the location of suspicious subsurface features which may represent buried tanks or drum disposal areas.

### Method

A geophysical contractor will conduct the magnetometer survey. A geophysical survey of the site's magnetic field will be completed utilizing a field magnetometer and electromagnetic induction. The field magnetometer measures the strength of the site's magnetic field regardless of the orientation of the magnetic lines of force. During the performance of the geophysical survey, data for the preparation of a field map will be collected. The final product of this survey will include a description of the site, contour maps, and an explanation of how the survey was conducted.

A correction for diurnal and micropulsation time variations is not necessary because the site and anticipated anomalies are relatively small in area (less than 1 square mile), and subsurface anomalies from buried objects of interest should be relatively large (greater than 100 gammas).

The map showing the distribution of magnetic field strength over the site will be compared with the observed field conditions (including the location of known interfering objects such as vehicles, overhead power lines, and surface debris). By comparison, those magnetic anomalies, which cannot be explained by, observed site conditions, will be presumed to be a result of buried subsurface material (e.g., drums, tanks, metal debris, etc.). The depth of detection for suspect objects (such as steel drums) may vary according to orientation, method of manufacture and condition, and numbers present. Steel drums, such as those suspected to be present at this site, may be detected to depths of 40 feet.

### Study Area

The area of the properties to be surveyed will be evaluated in the field. Magnetometer surveys will be conducted at a total of four sites (P, Q, R, and S) within Area 2. A general area for Site R survey site has been delineated and provided on Figure 10 (Fill Area Location Map). Overall site dimensions for the survey sites will be adjusted based upon the findings of the source area boundary delineation activities discussed in Section 5.2.1.1.

### Field Procedure

The following field equipment and procedures will be employed during this geophysical investigation.

### Equipment

A Geometrics 858 Cesium or a Geometrics 856AX Total Field Magnetometer will be used to collect the field data. Field procedures and operation of the instruments will be in accordance with the recommended manufacturer's field procedure and application manual.

Calibrated field survey equipment consisting of marked survey line, tape rulers, highway danger cones, and marked wooden stakes will be utilized to establish measurement locations.

### Measurement Point/Grid Surveying

The established survey lines will be marked in the field using a premarked survey line to maintain straight and precise station locations. Profiles will be completed along a straight line with an unobstructed line of sight. The corners of each of the gridded areas will be marked with temporary corner stakes to permit the relocation of the measurement points within each site.

### Data Processing

Following completion of the field phase of investigation, the following data processing will be performed:

- Explanation of where and how the survey was performed
- Description of each of the four sites (P, Q, R, S) in terms of magnetic anomalies detected

- A contour map of these data will be produced showing the location of the measurement points and the corresponding magnetometer reading.

### Test Trenches

#### Rationale

Test trenches will be installed at this site to confirm the presence of buried drums of tanks. One test trench will be installed at each site. The waste disposal areas within Area 2 were used for disposal of municipal and industrial waste as well as construction debris. Magnetic anomalies are likely to be numerous, intense, and widespread. If no location criteria other than the presence of a magnetic anomaly is used to determine whether or not a test trench is appropriate, disturbance of a significant portion of each disposal area is likely to result. Excessive trenching could result in unacceptable risks to the community, on-site workers and the environment.

For this reason, four selection criteria will be used to identify where to install each test trench. Test trenching will be done at the location of the largest magnetic anomaly that coincides with:

1. A soil gas concentration high,
2. Drum or tank disposal locations identified by historical air photo interpretation,
3. An area of high groundwater concentrations (greater than 10,000 ppb) as identified by the 1998 Ecology and Environment Data Report, and
4. Major magnetic anomalies reported in the 1988 Ecology and Environment "Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois".

Care will be taken not to place major emphasis on the comparison of historical groundwater concentrations and magnetic anomalies due to the extent of historical industrial groundwater pumping in the area.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. These will be removed, provided confined spaced entry is not needed to retrieve a drum. Trenches will not be entered to recover drums because of the danger inherent in such activities. Test trench locations will be determined using a GPS and recorded for future reference in the event drum removal is appropriate.

Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil, resulting from rupture of drums during removal, will be cleaned up by absorbing any liquid materials and placing the absorbent, solid waste, and contaminated soil in bulk containers. Over-packed drums and bulk solid and liquid containers will be stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the disposal area will be noted in the field log and photographed.

### Field Procedure

Anomaly test trench locations will be selected in the field based upon the parameters outlined in the Rationale section, and with the concurrence of the USEPA Region V or its designee.

To complete the anomaly test trench, a track-mounted or wheel-mounted hoe will be utilized. The depth to the top of buried anomalies is not expected to extend past 40 feet below grade; thus, a smaller piece of equipment may be utilized for these anomaly test trenches (in comparison to the trenches completed for delineation of the fill area boundaries). Trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching will follow OSHA rules for excavations. A PID, CGM, and a RAM will be used on a continuous basis to monitor the anomaly test trenches for hazardous conditions. The hoe operator will have a separate supplied-air system.

Anomaly test trenches will be advanced until evidence as to the source of the anomaly is found or to a maximum depth of 40 feet, where possible. Should groundwater infiltration and/or poor soil stability result in the inability to complete a test trench to 40 feet, the trenching will be terminated at that location. No accommodations will be made to de-water test trenches or manage groundwater during excavation activities, due to the need to minimize the generation of investigation-derived wastes.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events.

If intact drums are found during anomaly test trench completion, they will be removed, over-packed, and stored in an area to be designated in accordance with the requirements of 29 CFR 1910.120(j). For planning purposes, it is anticipated that up to ten over-packs will be necessary per site and that one day of anomaly test trenching will occur at each of the four sites. Handling of investigation-derived wastes from these activities is discussed in Section 9.

A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

### 5.4.1.5 Leachate Samples

#### Rationale

A 2-inch diameter well, screened at the bottom of the fill material, will be installed in one of the four waste characterization borings completed at this site. The purpose of this well is to characterize leachate at the site. The well will be sampled and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and dioxin. The analytical methods are presented in Table 1.

#### Field Procedure

#### Well Installation

The depth and screened interval for the well will be determined in accordance with the subsurface stratigraphy observed during Geoprobe® waste sampling activities. It is expected that the waste at the site extends to approximately 40 feet bgs. Unless observed conditions indicate otherwise, a screened interval of 10 feet will be used. The well will be seated at the bottom of the waste. A 4-1/4 inch ID hollow-stem auger will be used to advance the boring to the bottom of the waste material. The well will be constructed of two-inch diameter, schedule 40 PVC casing and 0.010-inch slotted schedule 40 PVC well screen. A sand pack, consisting of silica sand, will be installed from the bottom of the well to two feet above the well screen. A bentonite seal with a thickness of between two feet and three feet will be installed directly above the sand pack. The remaining annular space will be filled with a bentonite and cement grout. The well will be completed with an aboveground well protector and a locking cap.

Following installation of the leachate well, the top of casing and ground surface will be surveyed to establish well and grade elevations and well location. Well installation details will be documented on a test boring log (Appendix D) and in the field notebook. The leachate well will generally be installed according to the typical well construction diagrams and standard procedures presented in Appendix G.

Following completion of monitoring well construction activities, the water level will be allowed to stabilize and will then be gauged to determine groundwater elevation and the total volume of groundwater in the well. After the water level in the well has been determined, the well will be developed to remove the fines from the sand pack. The development will consist of pumping or bailing the well, following the protocol described later in this section.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 9 displays the approximate leachate monitoring well location for Site R.

### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

## 5.4.2 Hydrogeology

### 5.4.2.1 Alluvial Aquifer

#### Horizontal Extent of Contaminant Migration

#### Rationale

Groundwater samples will be collected in the alluvial aquifer downgradient of this waste disposal area. The purpose of this sampling is to define the extent of migration away from the source area and to provide information for the Human Health Risk Assessment.

Groundwater samples will be collected at three sampling stations located on the west property boundary of Site R. Unfiltered groundwater samples will be collected every 10 feet from the water table to the bottom of the aquifer using push sampling technologies such as Geoprobe®, HydroPunch®, Microwell®, Waterloo Profiler® or equivalent low-flow sampling techniques. Aquifer saturated thickness is estimated to be approximately 120 feet with depth to water at 20 feet bgs and bottom of the aquifer at 140 feet bgs. All samples will be analyzed for VOCs and SVOCs. Additionally, unfiltered samples will be collected at 40 foot intervals (20, 60, 100, and 140 foot bgs) and analyzed for pesticides, herbicides, PCBs, metals, and several geochemical parameters (presented in Table 1). Dioxin will be analyzed only at the sampling station closest to Site R. For dioxin analysis, unfiltered groundwater samfes will be collected at the top, middle, and bottom of the saturated zone (e.g., 20, 80, 140 feet bgs).

Experience at other sites indicates that push-sampling technologies such as Geoprobe® can reach depths of 60 feet. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe® sampler or equivalent sampling technology cannot penetrate to the required depth, Microwells® will be used to collect groundwater samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 feet can be achieved. If the required sampling depths cannot be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the alluvial aquifer groundwater sampling is presented in Table 4.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Area 2.

**Field Procedure**

**Establishment of Boreholes**

**Push Point**

Using the hydraulic push system of a Geoprobe®, a 4-foot stainless steel sampler with a wire wrap (slot size of 0.004 inches) will be pushed to the desired sample depth. A bailer or ball and check valve will be sent down to the slotted portion of the sampler to collect the groundwater sample. The groundwater sample will be retrieved to the surface and placed in a sample container. The Geoprobe® will then drive the sampler to the next desired sample depth, by connecting clean sections of push rods to the Geoprobe®, and a second groundwater sample will be collected here. This process will be continued until all samples are collected.

**MicroWell®**

It is anticipated the above sampling method will be used, as feasible. However based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered, which will stop the Geoprobe®. Should this occur, MicroWells® will be installed to use as the sample collection point. The MicroWells® will be hydraulically pushed to the appropriate depth, and the sampling procedure described above will be followed. Once the sample is collected, the MicroWell® will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced further in the same hole. This procedure will be repeated until all samples are collected.

Should MicroWell® installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which groundwater will flow. Once the sample is collected, the augers will be advanced further for collection at the next sample depth. This procedure will be repeated until all samples are collected within the borehole.

All Geoprobe®, MicroWell®, or Waterloo Profiler® holes will be sealed with grout from the bottom up and the surface will be returned to it's original condition after completion of sampling at each location. A PID, explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

### Groundwater Pre-Sampling and Borehole Sampling

Appendix I presents the protocol for groundwater sampling activities.

### 5.4.2.2 Bedrock Groundwater

### Vertical Extent of Contaminant Migration

### Rationale

One bedrock well will be installed downgradient of this site. The purpose of the bedrock sampling is to determine the extent of organic and inorganic constituent vertical migration from the site. Steel surface casing will be installed 5 feet into bedrock.

After installing the surface casing 5 feet into bedrock, the bedrock will be cored to a depth of 20 feet below the bottom of the casing. Cores will be digitally photographed in color against a scale and evaluated for porosity by examination and petrographic thin sections. One thin section will be made for each 2 feet of bedrock core. A 2-inch diameter, 5-foot-long screen and casing will be installed in the borehole. The screen will be filter-packed, sealed and grouted from 3 feet above the top of the filter-pack to grade. An unfiltered groundwater sample will be collected from the well following installation and development and will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the bedrock groundwater sampling is presented in Table 5.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Site R.

### Field Procedure

Mud rotary drilling methods will be used to drill the borehole to set the surface casing and to drill 5 feet into the top of bedrock. Coring will then be accomplished using wireline coring barrels to generate a 2-inch thick minimum core. Coring will continue for 20 feet into the bedrock. The drilling and sampling procedure will be as follows:

1. A temporary 10-inch ID steel casing will be installed from ground surface to 10 feet bgs. A bentonite/cement grout will be used to fill the annular space.
2. A 8-3/4-inch ID tri-cone bit will then be used to drill down to 145 feet. A 5-inch ID steel casing will be installed from ground surface to 145 feet bgs. A bentonite/cement grout will be used to fill the annular space.
3. Wireline coring barrels (NX rods) will be used to core 20 feet into the bedrock (165 feet bgs). The coring barrels will be retrieved and opened to collect the core sample.
4. Core samples will be photographed and described on test boring logs. Descriptions will follow the procedures outlined below.
5. The borehole will then be reamed to a 4-7/8-inch diameter. A 2-inch PVC casing (schedule 80) will be installed from ground surface to 165 feet bgs (20 feet into bedrock). The PVC casing will have a 5-foot long screen (0.010-inch slots). A bentonite seal with a minimum thickness of two feet will be installed directly above the sand pack. This bentonite seal will be 3 feet in length. The remaining annular space will be filled with a bentonite and cement grout.
6. The temporary 10-inch I.D. steel casing will be removed and the well will be completed with an aboveground well protector and a locking cap.
7. Well development or purging may be necessary before collecting groundwater samples from the cased/screened hole in the bedrock. The procedures for both well development and well purging are presented below.
8. Water level measurements will then be collected, prior to sampling the bedrock groundwater. The procedure for measuring water levels is also presented below.
9. The bedrock groundwater sample collection method is presented after the procedure for water level measurements.

### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

### Description of Rock Samples

As mentioned earlier in this section, the rock core will be evaluated via photographs and petrographic thin sections. The geologists and geotechnical engineers will write their description of rock samples with a consistent format. A detailed order and presentation of selection of data are presented in Appendix J.

### Groundwater Flow Direction (water levels)

Water levels will be measured quarterly for one year in the bedrock well and used to prepare water-level elevation maps. These will show seasonal changes in groundwater level and flow direction. Water level measurements will be conducted according to the same protocol outlined in Appendix I.

### Groundwater Flow Rate (slug tests)

### Rationale

Falling and rising head slug tests will be performed on the bedrock well, using a slug of known volume and in-well, short-time interval, automatic water-level recorders. With the falling-head and rising-head slug test data, aquifer hydraulic conductivity will be calculated for the well. Measured groundwater gradients and calculated aquifer hydraulic conductivities will be used to determine groundwater flow rates.

**Field Procedure**

Appendix K presents the field protocols for the completion of *in situ* hydraulic conductivity (slug) tests.

Slug test data will be downloaded from the data logger each day. The data will be reviewed for errors. If necessary, a slug test will be re-conducted.

### 5.4.3 Soil

#### 5.4.3.1 Surface Soil Samples

**Rationale**

Four surface soil samples (0 to 0.5 feet) will be collected at this disposal site. These samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment and Ecological Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the surface soil sampling is presented in Table 6.

Figure 9 presents approximate soil sample locations in Site R.

**Field Procedure**

Surface soil samples will be discrete. A discrete sample represents a single location in the soil column. The soil samples will be collected from the Geoprobe® borings.

Appendix C presents the standard operating procedure for waste and soil sample collection.

#### 5.4.3.2 Subsurface Soil Samples

**Rationale**

Four subsurface soil samples (0.5 to 6 feet) will be collected at each disposal site. As with the surface soil samples, the subsurface samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the subsurface soil sampling is presented in Table 7.

Figure 9 presents approximate soil sample locations for Site R.

**Field Procedure**

The four soil samples collected at this site will be collected at the location of each waste sample boring. The subsurface soil samples will be collected in the same manner as the waste samples.

Appendix C presents the standard operating procedure for waste and soil sample collection.

### 5.4.4 Air

#### 5.4.4.1 Rationale

Two upwind and two downwind ambient air samples will be collected to determine the tendency of site constituents to enter the atmosphere and local wind patterns. Air sampling data will be used in the Human Health Risk Assessment and Ecological Risk Assessment. Samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and dioxin.

Twenty-four hour cumulative duration sorbent tube/PUF/PM2.5 samples will be collected over a 1-day period, using the sampling protocols provided in Appendix L. Two upwind and two downwind samplers will be installed at the site during weather likely to produce emissions (e.g. hot and dry conditions in August). Sampling locations will be selected in the field with the concurrence of USEPA Region V or his designee. Sorbent tube samplers will be used for VOC data collection. Polyurethane foam (PUF) samplers will be used for SVOC, PCB, pesticide, herbicide, and dioxin data collection. PM2.5 samplers will be used for metal data collection

Ambient air sample collection is required to measure airborne levels of contaminants that may be evolving from the site. A 24-hour sample duration is required to average the air emission differences that may occur from the day time to night time cycle from on-site and off-site conditions and activities. Also, air sample collection locations need to be positioned on the site to collect up wind and down wind samples for differentiation of constituents originating from the surrounding area and those originating from the site. The sample protocol will collect site samples over a 1-day time period on a warm, dry day.

The level of detection for SVOCs required by USEPA Region V needs to consider sensitivity and selectivity to analyze complex samples. Based on this need, the analytical method of choice is gas chromatography coupled with mass spectrometry (GC/MS) for detection. Based on the GC/MS analytical method and its sensitivity level, the air sample volume needs to exceed 325 standard cubic feet. This enables the collection of a sufficient quantity of SVOCs to meet the level of detection required by USEPA Region V.

The sample method to meet the above requirements for SVOC measurement is USEPA Method TO-13, as identified in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (June 1988). This method will use a Graseby/General Metal Works, Inc. high volume air sampling unit or equivalent for sample collection. Sample collection will consist of drawing an ambient air sample at a high volume flow rate through a PUF collection media over a 24-hour time period. The samples will be submitted for analysis of the TO-13 list of SVOCs. Method TO-1 will be used to analyze VOCs. Method TO-13 will be used for pesticides, herbicides, and PCBs. Method TO-9 will analyze for dioxins.

Table 8 is a sample and analysis summary of this activity.

#### 5.4.4.2 Field Procedure

The following procedure will be used for ambient air samples:

- Place the sorbent tube samplers, PUF samplers, and PM2.5 samplers at upwind and downwind locations.
- Locate sampling positions in an unobstructed area, at least two meters from any obstacle to air flow. Sample locations will be selected in the field with the concurrence of the USEPA Region V, or its designee.
- No local power supply is readily available at the sites. Therefore, gasoline- or diesel-powered generators will be positioned at downwind locations from the sample collection positions. They will supply the electricity for the samplers.
- Record wind direction and velocity readings.

- Follow sample collection protocols identified in methods TO-1, TO-13, and TO-9 (Appendix C) for sample preparation, calibration, collection, laboratory preparation and shipment, and calculations. Sample data sheets are provided in Appendix L.

### 5.4.5 Stormwater Runoff

#### 5.4.5.1 Rationale

One stormwater runoff grab sample will be collected at a downgradient location within this site, in an effort to characterize runoff from the site during storm events. Samples will be collected within the primary drainage route, leading from the site to the Mississippi River. This sampling will be conducted at Sites Q and R because they are on the wet side of the floodwall and levee. The other three sites (O, P, and S) are on the dry side of the floodwall and levee and therefore have no drainage route to the Mississippi River. Samples will be collected during three storms to determine variability of constituent concentrations in site runoff. A first flush sample will be collected utilizing an automated sampling device. A first flush sample is one collected at the very beginning of a storm event (e.g., as the first flow comes through). Collection of a first flush sample insures that any contamination on the ground surface prior to the storm event will be collected before it has the opportunity to wash away. Storm water samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

The analytical methods are presented in Table 1. Table 9 presents a sample and analysis summary for storm water runoff samples to be collected.

The Site R sample location for stormwater runoff is shown on Figure 9.

#### 5.4.5.2 Field Procedure

Refer to Appendix M for the standard method of storm water sample collection.

The following method will be used for collection of storm water samples:

1. Identify the primary storm water drainage route, running from the site to the Mississippi River. Figure 9 of this FSP presents approximate storm water sampling locations for Site O.
2. Collect the sample during a rainfall, which results in a discharge. A storm water sample will be collected during three separate storm events (for a total of three samples per site).
3. Set up appropriate parameters on automated sampler.

4. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.

5. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection, except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.

6. Put on a clean pair of disposable gloves.

7. Set sampler to sample containers for the VOC sample, prior to filling other sample containers. Verify that there is no air in the sealed sampled container.

8. Transfer sample to appropriate containers for shipment to laboratory.

9. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.

10. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.

11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.

12. Record the physical appearance of the storm water observed during sampling in the field notebook.

### Treatability Tests

#### Rationale

The AOC requires that the SSP present a pilot test program for any treatment technologies lacking sufficient information on implementability and effectiveness. Data gaps exist for off-site incineration, off-site disposal, and on-site thermal desorption for the waste and on-site and off-site physical/chemical treatment, and off-site biological treatment for leachate.

A total of five composite waste samples (one for each site) will be collected for waste treatability testing and sent to appropriate facilities operators for waste profiling, material handling characterization and evaluation of the feasibility of disposing of the waste material by off-site incineration, off-site disposal, and on-site thermal desorption. In addition, five composite leachate samples (one for each site) will be collected for treatability testing to determine if the leachate can be discharged directly to American Bottoms POTW without resulting in pass through and/or interference.

One sample will be collected from each waste disposal area for waste treatability testing. The sample will be made from aliquots collected from the four waste characterization borings installed at each disposal area. One sample will be collected for the leachate treatability testing from each of the five-leachate sampling wells.

**Sample Collection**

The five composite waste samples that will be collected for treatability testing will be retained from the four-waste/soil borings that will be advanced at each waste disposal area. All of the material recovered from the Geoprobe® samples that are not needed for the other chemical analyses will be composited in 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facilities.

The leachate sample that will be collected for treatability testing will be collected during leachate sampling activities. An equal amount of leachate will be removed, via bailer or pump, from each of the five-leachate monitoring wells and placed in separate 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facility.

### 5.4.6 Seep Investigation

#### 5.4.6.1 Rationale

A visual reconnaissance survey will be undertaken along the riverbank adjacent to Site R to assess the presence of seeps and their impacts, if any, on the Mississippi River. The locations of any seeps observed will be located with a GPS, photographed, and if sufficient quantity is present, sampled for VOC, SVOC, PCBs, dioxin, herbicide, pesticide, and metals. Where appropriate, several smaller seeps in close proximity to each other may be sampled as a single location. If sample volume is limited, sample containers will be prioritized and filled in order of analytical parameters as presented above.

The analytical methods are presented in Table 1.

#### 5.4.6.2 Field Procedure

Refer to Appendix M for the standard method of seep water sample collection.

The following method will be used for collection of seep water samples:

1. Identify the seep location(s) along the riverbank and note location.
2. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.
3. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection, except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.
4. Grab sampling procedures and preservation of the collected seep water samples will follow the methods described in the current edition of "Standard Methods for the Examination of Water and Wastewater" (published by the American Public Health Association).
5. Put on a clean pair of disposable gloves.
6. Use a dipping utensil to retrieve a sample.
7. Fill sample containers for the VOC sample, prior to filling other sample containers. Verify that there is no air in the sealed sampled container.
8. Fill remaining sample containers.
9. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.
10. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.
11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.

12. Record the physical appearance of the storm water observed during sampling in the field notebook.

## 5.5 SITE S

### 5.5.1 Waste Characterization

#### 5.5.1.1 Delineation of Source Area Boundaries – Test Trenches

**Rationale**

Historical air photos will be obtained for this site. These photos will be used to define the areal extent of the site over time and to determine the boundaries of the waste disposal area. Boundaries of the site on each photo will be observed. To define the maximum extent of fill, the tracings for the site will be overlain and a line will be drawn around the outside limit of the composite waste disposal area boundary. Results of the historical air photo analysis will be used to prepare a map for the site, showing disposal area boundaries. If stereoscopic evaluation of historical air photographs allows identification of the deepest portion of a waste disposal area, one of the four waste characterization borings discussed below will be done at that location.

Test trenches will be used to confirm the boundaries of the waste disposal area identified through air photo analysis. One trench will be installed on each side of the waste disposal area. Thus, there will be a total of four trenches for the site. The four trenches will be located at the midpoint of the four longest sides of the defined site boundary. A GPS system will be used to document the locations on aerial site maps. Test trenches will start outside the defined boundary of the disposal area and move toward the defined boundary. When fill materials are encountered, the disposal area boundary will be compared to those identified in the air photo analysis and trenching at that location will then be terminated.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. Intact drums will be removed, provided confined space entry is not needed to retrieve a drum. Trenches will not be entered to recover drums due to the inherent danger in such activities. Test trench locations will be determined using a GPS system. The trench locations will be recorded for future reference, in the event drum removal is appropriate. The drum removal contractor, in accordance with the requirements of 29 CFR 1910.120(j) will handle drums recovered during trenching activities. Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil resulting from rupture of drums during removal will be cleaned up by absorbing any liquid materials. The absorbent, solid waste, and contaminated soil will be placed in bulk containers. The over-packed drums and these bulk containers will be temporarily stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums and wastes will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the fill area will be noted in the field log and photographed.

Trenching locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

#### Field Procedure

All trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching activities will follow Occupational Safety and Health Administration (OSHA) rules for excavations.

Locations of test trenches for boundary confirmation of Site S are shown on Figure 11. A "competent" person, as defined in 29 CFR 1976.650, will observe the trenching activities and will have authorization to take corrective measures to respond to unsanitary, hazardous, or dangerous conditions to workers. A track-mounted hoe with an extended arm will be used for excavation. A photoionization detector (PID), combustible gas monitor (CGM), and a real-time aerosol monitor (RAM) will be used on a continuous basis to monitor the test trenches for hazardous conditions.

Trenching activities will begin outside the site boundary and move in towards the boundary. The trenching will extend vertically to a maximum depth of 40 ft bgs or to groundwater, whichever is encountered first. No accommodations will be made to dewater test trenches or manage groundwater during excavation activities in order to minimize the generation of investigation-derived wastes. The trenching will continue until waste material is encountered. Should waste materials be encountered initially, the trenching activities will proceed out and away from the boundary until native soils are encountered. Where native soils are encountered, the excavation will proceed to greater depth up to a maximum of 40 ft below grade, where possible. Should waste materials be encountered again within the test trench, this procedure will be repeated until no waste materials are encountered within the test trench. The location where no additional waste materials are encountered within the test trench will be designated as the extent of the site boundary for that location.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic, having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. The gross contamination will be removed from the excavator bucket with a shovel and/or potable water source prior to handling the cover material. Decontamination debris will be placed into the excavation trench prior to placement of cover material. Handling of investigation-derived wastes from these activities is discussed in Section 9.

Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events. A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

The location of the test trenches will be illustrated on a plan of the site. Digital photographs will be taken of the test trenches, the test trench walls, and any waste materials excavated. The number and location of each photograph will be identified on the field log for each test trench.

#### 5.5.1.2 Soil Gas Surveys

**Rationale**

A soil gas contractor will perform a soil gas survey at Site S. A shallow soil probe (5 feet) and on-site analysis of collected VOC vapors with a GC will be used in this survey. Soil gas samples will be collected at the center of the site and along each side, resulting in five sampling locations. The soil gas survey sampling points for Site S are displayed in Figure 12.

If detectable concentrations of Total VOCs are found in the soil gas samples at the disposal area boundary, the survey will be extended beyond that boundary. If extended beyond the boundary, soil gas samples will be collected at 100-foot intervals (0, 100, and 200 feet from the edge of the disposal area) along as many as four 200-foot long transects. Each transect will run perpendicular to the relevant sides of the disposal area. If VOCs are detected in soil gas at this site, up to twelve additional soil gas samples may be collected.

If twelve additional samples are not adequate to define the extent of VOC-containing soils in the disposal area, additional soil gas samples will be collected at 100-foot intervals along the appropriate transects until the limits of the impacted fill are determined. If soil gas surveys need to extend into areas for which there are no property access agreements, soil gas sampling will be suspended until access is obtained.

Sampling locations will be selected in the field with the concurrence of USEPA Region V RPM or his designee.

Table 2 is a sample and analysis summary for this activity.

**Field Procedure**

Direct push technology will be used to advance a retractable point holder to 5.5 feet below existing grade. The rods will then be pulled back to approximately 5 feet below existing grade to disengage the retractable point, therefore, exposing the sampling mechanism. Polyethylene tubing (0.125-inch diameter) will be lowered into the rods. The upper end of the polyethylene tubing will be connected to a 4-inch section of silicone tubing. This will then be attached to a section of polyethylene tubing coming from an active vacuum system and a vacuum will be placed in the tubing using a 60cc sample of soil gas will be withdrawn. From the silicone tubing using a 60cc disposable syringe with a stainless steel needle. The sample will then be directly injected into the on-site GC. The GC will provide a report of the total VOC concentrations.

Sample tubing will be removed from the probe and disposed. Probing rods and sampling

equipment will be removed from the boring. The probe boring will be filled with bentonite, to just bgs. The bentonite will be hydrated with potable water and the surface will be restored to its original condition. An SOP for the field GC is contained in Appendix A.

### 5.5.1.3 Waste Samples

**Rationale**

Four borings will be advanced at this site to characterize the waste materials present. Continuous samples will be collected from grade to two feet below the bottom of the waste material, which is estimated to be a maximum of 40 feet below grade. If wastes are encountered at depths greater than 40 feet bgs (bgs), the boring will continue until the bottom of the waste is encountered. Scaled, color digital photographs will be taken of each waste sample to provide a record of materials present in the disposal area.

One composite waste sample will be collected at each boring location (4 total composite waste samples), and analyzed for SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. In addition, a portion of the composite waste sample from above the water table will be extracted using TCLP procedures and analyzed for this same suite of analytes. Visual observations and PID readings will be used to identify whether or not waste is present in a continuous boring sample. If waste is present in a sample, it will be removed, segregated, temporarily stored and used at the completion of the soil boring to prepare a composite waste sample. Since VOC samples cannot be composited without losing volatiles, the waste with the highest PID readings will be used for VOC analysis.

Existing information (e.g., the 1998 Ecology and Environment report and the results of the aerial photograph analysis, soil gas surveys, and magnetometer surveys conducted as part of the SSP) will be used to select boring locations. Approximate waste characterization boring locations for Site S are shown on Figure 11. Additional waste characterization borings may be required by USEPA Region V as a result of variability in waste characteristics observed during the waste characterization boring program.

Table 3 is a sample and analysis summary for waste samples to be collected.

### Field Procedure

Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depths. Continuous samples will be collected from grade to 2 feet below the bottom of the waste material (estimated to be 40 feet bgs). Between each sample collection, the sampler will be retrieved to the surface and the samples removed from the disposable acetate liner within the sampler.

One composite waste sample will be collected from each boring. Each sample will be visually observed and monitored with PID readings, to determine whether waste is present. If waste is present in a sample, it will be removed, segregated, temporarily stored, and used at the completion of the soil boring to prepare a composite waste sample. The soil sample exhibiting the highest PID reading at each of the four boring locations within this site will be used for VOC analysis. A 5-gram EnCore® sampler will be used to collect VOC samples.

Refer to Appendix C for detailed soil/waste sampling procedures.

Descriptive logs of each boring will be prepared as described in Appendix E. The four waste borings generated at each of the five sites will also be used for surface and subsurface soil sample collection. All borings will be grouted to the surface, following retrieval of both the waste and soil samples.

**Logging Unconsolidated Samples**

The geologist logging samples will be responsible to interpret the samples following standard and acceptable methods. The geologist implementing this work plan will have training and experience logging boring samples. Soil will be logged according to applicable ASTM standards. As appropriate, ASTM standards will be used to log waste materials. Appendix E presents detailed instructions for logging soil and waste samples.

#### 5.5.1.4 Buried Drum and Tank Identification

**Magnetometer Survey**

**Rationale**

A magnetometer survey will be conducted at this site to identify anomalies indicative of drum disposal or buried tanks. Magnetometer measurements will be made at locations determined by superimposing a 50-foot by 50-foot grid on the disposal area.

Surface geophysical surveys, which map the distribution of the strength of the earth's magnetic field, have been proven useful in evaluating shallow and deep subsurface conditions at environmental sites. These geophysical surveys have been used to successfully locate buried objects containing magnetically susceptible materials (e.g., iron and nickel metals). The ability of geophysical equipment to locate buried objects is, for the most part, dependent on:

- The strength and orientation of the magnetic anomaly associated with the buried objects
- The strength and natural variation of the earth's magnetic field in response to local geology

- The influence of man-made surface features (such as power lines, buried utilities, vehicles, electric motors, etc.) which may interfere with the collection of data.

By comparing the known surface and geological conditions to a magnetic survey map that includes mapped surface feature interferences, and understanding possible geologic background effects, it is possible to identify the location of suspicious subsurface features which may represent buried tanks or drum disposal areas.

### Method

A geophysical contractor will conduct the magnetometer survey. A geophysical survey of the site's magnetic field will be completed utilizing a field magnetometer and electromagnetic induction. The field magnetometer measures the strength of the site's magnetic field regardless of the orientation of the magnetic lines of force. During the performance of the geophysical survey, data for the preparation of a field map will be collected. The final product of this survey will include a description of the site, contour maps, and an explanation of how the survey was conducted.

A correction for diurnal and micropulsation time variations is not necessary because the site and anticipated anomalies are relatively small in area (less than 1 square mile), and subsurface anomalies from buried objects of interest should be relatively large (greater than 100 gammas).

The map showing the distribution of magnetic field strength over the site will be compared with the observed field conditions (including the location of known interfering objects such as vehicles, overhead power lines, and surface debris). By comparison, those magnetic anomalies, which cannot be explained by, observed site conditions, will be presumed to be a result of buried subsurface material (e.g., drums, tanks, metal debris, etc.). The depth of detection for suspect objects (such as steel drums) may vary according to orientation, method of manufacture and condition, and numbers present. Steel drums, such as those suspected to be present at this site, may be detected to depths of 40 feet.

### Study Area

The area of the properties to be surveyed will be evaluated in the field. Magnetometer surveys will be conducted at a total of four sites (P, Q, R, and S) within Area 2. A general area for Site S survey site has been delineated and provided on Figure 12 (Fill Area Location Map). Overall site dimensions for the survey sites will be adjusted based upon the findings of the source area boundary delineation activities discussed in Section 5.2.1.1.

### Field Procedure

The following field equipment and procedures will be employed during this geophysical investigation.

### Equipment

A Geometrics 858 Cesium or a Geometrics 856AX Total Field Magnetometer will be used to collect the field data. Field procedures and operation of the instruments will be in accordance with the recommended manufacturer's field procedure and application manual.

Calibrated field survey equipment consisting of marked survey line, tape rulers, highway danger cones, and marked wooden stakes will be utilized to establish measurement locations.

### Measurement Point/Grid Surveying

The established survey lines will be marked in the field using a premarked survey line to maintain straight and precise station locations. Profiles will be completed along a straight line with an unobstructed line of sight. The corners of each of the gridded areas will be marked with temporary corner stakes to permit the relocation of the measurement points within each site.

### Data Processing

Following completion of the field phase of investigation, the following data processing will be performed:

- Explanation of where and how the survey was performed
- Description of each of the four sites (P, Q, R, S) in terms of magnetic anomalies detected
- A contour map of these data will be produced showing the location of the measurement points and the corresponding magnetometer reading.

### Test Trenches

#### Rationale

Test trenches will be installed at this site to confirm the presence of buried drums of tanks. One test trench will be installed at each site. The waste disposal areas within Area 2 were used for disposal of municipal and industrial waste as well as construction debris. Magnetic anomalies are likely to be numerous, intense, and widespread. If no location criteria other than the presence of a magnetic anomaly is used to determine whether or not a test trench is appropriate, disturbance of a significant portion of each disposal area is likely to result. Excessive trenching could result in unacceptable risks to the community, on-site workers and the environment.

For this reason, four selection criteria will be used to identify where to install each test trench. Test trenching will be done at the location of the largest magnetic anomaly that coincides with:

1. A soil gas concentration high,
2. Drum or tank disposal locations identified by historical air photo interpretation,
3. An area of high groundwater concentrations (greater than 10,000 ppb) as identified by the 1998 Ecology and Environment Data Report, and
4. Major magnetic anomalies reported in the 1988 Ecology and Environment "Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois".

Care will be taken not to place major emphasis on the comparison of historical groundwater concentrations and magnetic anomalies due to the extent of historical industrial groundwater pumping in the area.

Excavated soil and fill material will be returned to the test trench, with the exception of any intact drums. These will be removed, provided confined spaced entry is not needed to retrieve a drum. Trenches will not be entered to recover drums because of the danger inherent in such activities. Test trench locations will be determined using a GPS and recorded for future reference in the event drum removal is appropriate.

Recovered drums will be over-packed and stored pending disposal. Free product and contaminated soil, resulting from rupture of drums during removal, will be cleaned up by absorbing any liquid materials and placing the absorbent, solid waste, and contaminated soil in bulk containers. Over-packed drums and bulk solid and liquid containers will be stored at a controlled-access, fenced Investigation Derived Waste (IDW) Storage Area to be constructed at Site R. Recovered drums will be stored until the capacity of the storage pad is exceeded or the investigation is complete, whichever comes first. Any waste excavated that identifies the source of material present in the disposal area will be noted in the field log and photographed.

#### Field Procedure

Anomaly test trench locations will be selected in the field based upon the parameters outlined in the Rationale section, and with the concurrence of the USEPA Region V or its designee.

To complete the anomaly test trench, a track-mounted or wheel-mounted hoe will be utilized. The depth to the top of buried anomalies is not expected to extend past 40 feet below grade; thus, a smaller piece of equipment may be utilized for these anomaly test trenches (in comparison to the trenches completed for delineation of the fill area boundaries). Trenching activities will be conducted in a manner to protect existing utilities, structures, surface features, monitoring wells, and the general site environment. Additionally, trenching will follow OSHA rules for excavations. A PID, CGM, and a RAM will be used on a continuous basis to monitor the anomaly test trenches for hazardous conditions. The hoe operator will have a separate supplied-air system.

Anomaly test trenches will be advanced until evidence as to the source of the anomaly is found or to a maximum depth of 40 feet, where possible. Should groundwater infiltration and/or poor soil stability result in the inability to complete a test trench to 40 feet, the trenching will be terminated at that location. No accommodations will be made to de-water test trenches or manage groundwater during excavation activities, due to the need to minimize the generation of investigation-derived wastes.

As the trenching proceeds, spoils from the test trenches will be placed on polyethylene plastic having a minimum thickness of 6 millimeters. Provisions will be made to allow free liquids in the spoils to drain back to the trench. Spoils from each test trench will be segregated and returned to the excavation in reverse order of removal. Backfilling will be conducted in a manner to minimize ponding of water over the trench. A silt fence will be installed around the perimeter of the trench to minimize runoff of surface soils during rain events.

If intact drums are found during anomaly test trench completion, they will be removed, over-packed, and stored in an area to be designated in accordance with the requirements of 29 CFR

1910.120(j). For planning purposes, it is anticipated that up to ten over-packs will be necessary per site and that one day of anomaly test trenching will occur at each of the four sites. Handling of investigation-derived wastes from these activities is discussed in Section 9.

A test trench at one location will be backfilled prior to the initiation of a test trench at another location. After completion of site investigation activities, the sites will be revegetated with grass. The silt fence will be maintained until revegetation is completed.

### 5.5.1.5 Leachate Samples

#### Rationale

A 2-inch diameter well, screened at the bottom of the fill material, will be installed in one of the four waste characterization borings completed at this site. The purpose of this well is to characterize leachate at the site. The well will be sampled and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals. The analytical methods are presented in Table 1.

#### Field Procedure

#### Well Installation

The depth and screened interval for the well will be determined in accordance with the subsurface stratigraphy observed during Geoprobe® waste sampling activities. It is expected that the waste at the site extends to approximately 40 feet bgs. Unless observed conditions indicate otherwise, a screened interval of 10 feet will be used. The well will be seated at the bottom of the waste. A 4-1/4 inch ID hollow-stem auger will be used to advance the boring to the bottom of the waste material. The well will be constructed of two-inch diameter, schedule 40 PVC casing and 0.010-inch slotted schedule 40 PVC well screen. A sand pack, consisting of silica sand, will be installed from the bottom of the well to two feet above the well screen. A bentonite seal with a thickness of between two feet and three feet will be installed directly above the sand pack. The remaining annular space will be filled with a bentonite and cement grout. The well will be completed with an aboveground well protector and a locking cap.

Following installation of the leachate well, the top of casing and ground surface will be surveyed to establish well and grade elevations and well location. Well installation details will be documented on a test boring log (Appendix D) and in the field notebook. The leachate well will generally be installed according to the typical well construction diagrams and standard procedures presented in Appendix G.

Following completion of monitoring well construction activities, the water level will be allowed to stabilize and will then be gauged to determine groundwater elevation and the total volume of groundwater in the well. After the water level in the well has been determined, the well will be developed to remove the fines from the sand pack. The development will consist of pumping or bailing the well, following the protocol described later in this section.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 11 displays the approximate leachate monitoring well location for Site S.

### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

### 5.5.2 Hydrogeology

#### 5.5.2.1 Alluvial Aquifer

***Horizontal Extent of Contaminant Migration***

**Rationale**

Groundwater samples will be collected in the alluvial aquifer downgradient of this waste disposal area. The purpose of this sampling is to define the extent of migration away from the source area and to provide information for the Human Health Risk Assessment.

Groundwater samples will be collected at three sampling stations located on an east/west transect between the downgradient boundary of Site S and the upgradient boundary of Sites Q and R. Unfiltered groundwater samples will be collected every 10 feet from the water table to the bottom of the aquifer using push sampling technologies such as Geoprobe®, HydroPunch®, Microwell®, Waterloo Profiler® or equivalent low-flow sampling techniques. Aquifer saturated thickness is estimated to be approximately 120 feet with depth to water at 20 feet bgs and bottom of the aquifer at 140 feet bgs. All samples will be analyzed for VOCs and SVOCs. Additionally, unfiltered samples will be collected at 40 foot intervals (i.e., 20, 60, 100, and 140 foot bgs) and analyzed for pesticides, herbicides, PCBs, metals, and several geochemical parameters (presented in Table 1). Dioxin will be analyzed only at the sampling station closest to Site S. For dioxin analysis, unfiltered groundwater samples will be collected at the top, middle, and bottom of the saturated zone (e.g., 20, 80, 140 feet bgs).

Experience at other sites indicates that push-sampling technologies such as Geoprobe® can reach depths of 60 feet. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe® sampler or equivalent sampling technology cannot penetrate to the required depth, Microwells® will be used to collect groundwater samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 feet can be achieved. If the required sampling depths cannot be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the alluvial aquifer groundwater sampling is presented in Table 4.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Area 2.

**Field Procedure**

**Establishment of Boreholes**

**Push Point**

Using the hydraulic push system of a Geoprobe®, a 4-foot stainless steel sampler with a wire wrap (slot size of 0.004 inches) will be pushed to the desired sample depth. A bailer or ball and check valve will be sent down to the slotted portion of the sampler to collect the groundwater sample. The groundwater sample will be retrieved to the surface and placed in a sample container. The Geoprobe® will then drive the sampler to the next desired sample depth, by connecting clean sections of push rods to the Geoprobe®, and a second groundwater sample will be collected here. This process will be continued until all samples are collected.

**MicroWell®**

It is anticipated the above sampling method will be used, as feasible. However based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered, which will stop the Geoprobe®. Should this occur, MicroWells® will be installed to use as the sample collection point. The MicroWells® will be hydraulically pushed to the appropriate depth, and the sampling procedure described above will be followed. Once the sample is collected, the MicroWell® will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced further in the same hole. This procedure will be repeated until all samples are collected.

Should MicroWell® installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which groundwater will flow. Once the sample is collected, the augers will be advanced further for collection at the next sample depth. This procedure will be repeated until all samples are collected within the borehole.

All Geoprobe®, MicroWell®, or Waterloo Profiler® holes will be sealed with grout from the bottom up and the surface will be returned to it's original condition after completion of sampling at each location. A PID, explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

#### Groundwater Pre-Sampling and Borehole Sampling

Appendix I presents the protocol for groundwater sampling activities.

### 5.5.2.2 Bedrock Groundwater

#### Vertical Extent of Contaminant Migration

#### Rationale

One bedrock well will be installed downgradient of this site. The purpose of the bedrock sampling is to determine the extent of organic and inorganic constituent vertical migration from the site. Steel surface casing will be installed 5 feet into bedrock.

After installing the telescoping surface casing 5 feet into bedrock, the bedrock will be cored to a depth of 20 feet below the bottom of the casing. Cores will be digitally photographed in color against a scale and evaluated for porosity by examination and petrographic thin sections. One thin section will be made for each 2 feet of bedrock core. A 2-inch diameter, 5-foot-long screen and casing will be installed in the borehole. The screen will be filter-packed, sealed and grouted from 3 feet above the top of the filter-pack to grade. An unfiltered groundwater sample will be collected from the well following installation and development and will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the bedrock groundwater sampling is presented in Table 5.

Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee. Figure 4 displays approximate groundwater sampling locations for Site S.

#### Field Procedure

Mud rotary drilling methods will be used to drill the borehole to set the surface casing and to drill 5 feet into the top of bedrock. Coring will then be accomplished using wireline coring barrels to generate a 2-inch thick minimum core. Coring will continue for 20 feet into the bedrock. The drilling and sampling procedure will be as follows:

1. A temporary 10-inch ID steel casing will be installed from ground surface to 10 feet bgs. A bentonite/cement grout will be used to fill the annular space.
2. A 8-3/4-inch ID tri-cone bit will then be used to drill down to 145 feet. A 5-inch ID steel casing will be installed from ground surface to 145 feet bgs. A bentonite/cement grout will be used to fill the annular space.
3. Wireline coring barrels (NX rods) will be used to core 20 feet into the bedrock (165 feet bgs). The coring barrels will be retrieved and opened to collect the core sample.
4. Core samples will be photographed and described on test boring logs. Descriptions will follow the procedures outlined below.
5. The borehole will then be reamed to a 4-7/8-inch diameter. A 2-inch PVC casing (schedule 80) will be installed from ground surface to 165 feet bgs (20 feet into bedrock). The PVC casing will have a 5-foot long screen (0.010-inch slots). A bentonite seal with a minimum thickness of two feet will be installed directly above the sand pack. This bentonite seal will be 3 feet in length. The remaining annular space will be filled with a bentonite and cement grout.
6. The temporary 10-inch I.D. steel casing will be removed and the well will be completed with an aboveground well protector and a locking cap.
7. Well development or purging may be necessary before collecting groundwater samples from the cased/screened hole in the bedrock. The procedures for both well development and well purging are presented below.
8. Water level measurements will then be collected, prior to sampling the bedrock groundwater. The procedure for measuring water levels is also presented below.
9. The bedrock groundwater sample collection method is presented after the procedure for water level measurements.

### Well Development

Newly installed wells will require development to clear the well of accumulated sediments. Appendix H presents the standard operating procedure (SOP) for well development.

### Well Purging (if necessary)

After installation and development and prior to sampling, the well may be purged to remove the standing water column from the well casing. The SOP for well purging is presented in Appendix H with the procedure for well development.

### Water Level Measurements

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

### Groundwater Pre-Sampling and Well Sampling

Appendix I presents the protocol for groundwater sampling activities.

### Description of Rock Samples

As mentioned earlier in this section, the rock core will be evaluated via photographs and petrographic thin sections. The geologists and geotechnical engineers will write their description of rock samples with a consistent format. A detailed order and presentation of selection of data are presented in Appendix J.

### Groundwater Flow Direction (water levels)

Water levels will be measured quarterly for one year in the bedrock well and used to prepare water-level elevation maps. These will show seasonal changes in groundwater level and flow direction. Water level measurements will be conducted according to the same protocol outlined in Appendix I.

### Groundwater Flow Rate (slug tests)

#### Rationale

Falling and rising head slug tests will be performed on the bedrock well, using a slug of known volume and in-well, short-time interval, automatic water-level recorders. With the falling-head and rising-head slug test data, aquifer hydraulic conductivity will be calculated for the well. Measured groundwater gradients and calculated aquifer hydraulic conductivities will be used to determine groundwater flow rates.

**Field Procedure**

Appendix K presents the field protocols for the completion of *in situ* hydraulic conductivity (slug) tests.

Slug test data will be downloaded from the data logger each day. The data will be reviewed for errors. If necessary, a slug test will be re-conducted.

### 5.5.3 Soil

#### 5.5.3.1 Surface Soil Samples

**Rationale**

Four surface soil samples (0 to 0.5 feet) will be collected at this disposal site. These samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment and Ecological Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the surface soil sampling is presented in Table 6.

Figure 11 presents appropriate soil sample locations in Site S.

**Field Procedure**

Surface soil samples will be discrete. A discrete sample represents a single location in the soil column. The soil samples will be collected from the Geoprobe® borings.

Appendix C presents the standard operating procedure for waste and soil sample collection.

#### 5.5.3.2 Subsurface Soil Samples

**Rationale**

Four subsurface soil samples (0.5 to 6 feet) will be collected at each disposal site. As with the surface soil samples, the subsurface samples will be collected at the location of each waste sample boring to provide information for the Human Health Risk Assessment. Scaled, color digital photographs will be taken of each soil sample to provide a record of materials present at this site. Each sample will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A detailed sample and analysis summary for the subsurface soil sampling is presented in Table 7.

Figure 11 presents appropriate soil sample locations for Site S.

**Field Procedure**

The four soil samples collected at this site will be collected at the location of each waste sample boring. The subsurface soil samples will be collected in the same manner as the waste samples.

Appendix C presents the standard operating procedure for waste and soil sample collection.

### 5.5.4 Air

#### 5.5.4.1 Rationale

Two upwind and two downwind ambient air samples will be collected to determine the tendency of site constituents to enter the atmosphere and local wind patterns. Air sampling data will be used in the Human Health Risk Assessment and Ecological Risk Assessment. Samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and dioxin.

Twenty-four hour cumulative duration sorbent tube/PUF/PM2.5 samples will be collected over a 1-day period, using the sampling protocols provided in Appendix L. Two upwind and two downwind samplers will be installed at the site during weather likely to produce emissions (e.g. hot and dry conditions in August). Sampling locations will be selected in the field with the concurrence of USEPA Region V or his designee. Sorbent tube samplers will be used for VOC data collection. Polyurethane foam (PUF) samplers will be used for SVOC, PCB, pesticide, herbicide, and dioxin data collection. PM2.5 samplers will be used for metal data collection

Ambient air sample collection is required to measure airborne levels of contaminants that may be evolving from the site. A 24-hour sample duration is required to average the air emission differences that may occur from the day time to night time cycle from on-site and off-site conditions and activities. Also, air sample collection locations need to be positioned on the site to collect up wind and down wind samples for differentiation of constituents originating from the surrounding area and those originating from the site. The sample protocol will collect site samples over a 1-day time period on a warm, dry day.

The level of detection for SVOCs required by USEPA Region V needs to consider sensitivity and selectivity to analyze complex samples. Based on this need, the analytical method of choice is gas chromatography coupled with mass spectrometry (GC/MS) for detection. Based on the GC/MS analytical method and its sensitivity level, the air sample volume needs to exceed 325 standard cubic feet This enables the collection of a sufficient quantity of SVOCs to meet the level of detection required by USEPA Region V.

The sample method to meet the above requirements for SVOC measurement is USEPA Method TO-13, as identified in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (June 1988). This method will use a Graseby/General Metal Works, Inc high volume air sampling unit or equivalent for sample collection. Sample collection will consist of drawing an ambient air sample at a high volume flow rate through a PUF collection media over a 24-hour time period. The samples will be submitted for analysis of the TO-13 list of SVOCs. Method TO-1 will be used to analyze VOCs. Method TO-13 will be used for pesticides, herbicides, and PCBs. Method TO-9 will analyze for dioxins.

Table 8 is a sample and analysis summary of this activity.

#### 5.5.4.2 Field Procedure

The following procedure will be used for ambient air samples:

- Place the sorbent tube samplers, PUF samplers, and PM2.5 samplers at upwind and downwind locations.
- Locate sampling positions in an unobstructed area, at least two meters from any obstacle to air flow. Sample locations will be selected in the field with the concurrence of the USEPA Region V, or its designee.
- No local power supply is readily available at the sites. Therefore, gasoline- or diesel-powered generators will be positioned at downwind locations from the sample collection positions. They will supply the electricity for the samplers.
- Record wind direction and velocity readings.

- Follow sample collection protocols identified in methods TO-1, TO-13, and TO-9 (Appendix C) for sample preparation, calibration, collection, laboratory preparation and shipment, and calculations. Sample data sheets are provided in Appendix L.

### Treatability Tests

#### Rationale

The AOC requires that the SSP present a pilot test program for any treatment technologies lacking sufficient information on implementability and effectiveness. Data gaps exist for off-site incineration, off-site disposal, and on-site thermal desorption for the waste and on-site and off-site physical/chemical treatment, and off-site biological treatment for leachate.

A total of five composite waste samples (one for each site) will be collected for waste treatability testing and sent to appropriate facilities operators for waste profiling, material handling characterization and evaluation of the feasibility of disposing of the waste material by off-site incineration, off-site disposal, and on-site thermal desorption. In addition, five composite leachate samples (one for each site) will be collected for treatability testing to determine if the leachate can be discharged directly to American Bottoms POTW without resulting in pass through and/or interference.

One sample will be collected from each waste disposal area for waste treatability testing. The sample will be made from aliquots collected from the four waste characterization borings installed at each disposal area. One sample will be collected for the leachate treatability testing from each of the five-leachate sampling wells.

#### Sample Collection

The five composite waste samples that will be collected for treatability testing will be retained from the four-waste/soil borings that will be advanced at each waste disposal area. All of the material recovered from the Geoprobe® samples that are not needed for the other chemical analyses will be composited in 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facilities.

The leachate sample that will be collected for treatability testing will be collected during leachate sampling activities. An equal amount of leachate will be removed, via bailer or pump, from each of the five-leachate monitoring wells and placed in separate 5-gallon buckets. Each bucket will be sealed, labeled and prepared for shipment to the appropriate facility.

## 5.6 BACKGROUND LOCATIONS

### 5.6.1 Hydrogeology

#### 5.6.1.1 Alluvial Aquifer

***Rationale***

Groundwater samples will be collected at three sampling stations located along Mississippi Avenue. One sampling station will be located downgradient of the Big River Zinc and Ethyl Corporation properties. A second sampling station will be located downgradient of Solutia's W.G. Krummrich facility. The third sampling station will be located downgradient of Cerro Copper and Sauget Area 1 Site I.

Unfiltered groundwater samples will be collected every 10 feet from the water table to the bottom of the aquifer. Push sampling technologies, such as Geoprobe®, HydroPunch®, Microwell®, Waterloo Profiler®, or equivalent, and low-flow sampling techniques will be used. Aquifer saturated thickness is estimated to be approximately 120 feet with depth to water at 20 feet bgs and bottom of the aquifer at 140 feet bgs. All samples will be analyzed for VOCs and SVOCs. Additionally, unfiltered samples will be collected at 40 foot intervals (i.e., 20, 60, and 100 foot bgs) and analyzed for pesticides, herbicides, PCBs, metals, and several geochemical parameters (Table 1).

Unfiltered groundwater samples will be collected at the top, middle, and bottom of the saturated zone (i.e. 20, 80, and 140 feet bgs) at the center background sampling location. These three samples will be analyzed for dioxin.

Experience at other sites indicates that push-sampling technologies such as Geoprobe® can reach depths of 60 feet. Depth of penetration can be increased at some locations by loosening the soil above the sampling horizon with a small-diameter solid stem auger before pushing the sampling probe to the required sampling depth. When the Geoprobe® sampler or equivalent sampling technology cannot penetrate to the required depth, Microwells® will be used to collect groundwater samples. These small-diameter wells are vibrated into place using a small vibratory hammer. Experience in deep aquifers at other sites indicates that sampling depths of 100 feet can be achieved. If the required sampling depths cannot be reached with either of these two technologies, conventional percussion drilling equipment will be used to drive 1-1/4 inch diameter drive points to the required sampling depths.

Table 1 presents the analytical methods. A sample and analysis summary for the background groundwater sampling is presented in Table 10.

Figure 4 displays approximate groundwater sampling locations for Area 2. Sampling locations will be selected in the field with the concurrence of USEPA Region V or its designee.

### Field Procedure

### Establishment of Boreholes

### Push Point

Using the hydraulic push system of a Geoprobe®, a 4-foot stainless steel sampler with a wire wrap (slot size of 0.004 inches) will be pushed to the desired sample depth. A bailer or ball and check valve will be sent down to the slotted portion of the sampler to collect the groundwater sample. The groundwater sample will be retrieved to the surface and placed in a sample container. The Geoprobe® will then drive the sampler to the next desired sample depth, by connecting clean sections of push rods to the Geoprobe®, and a second groundwater sample will be collected here. This process will be continued until all samples are collected.

### MicroWell®

It is anticipated the above sampling method will be used, as feasible. However, based on the location of the site within the Mississippi River flood plain, large gravel or cobbles may be encountered, which will stop the Geoprobe®. Should this occur, MicroWells® will be installed to use as the sample collection point. The MicroWells® will be hydraulically pushed to the appropriate depth, and the sampling procedure described above will be followed. Once the sample is collected, the MicroWell® will be pulled, the screen point decontaminated according to the method described below, and a new well will be advanced further in the same hole. This procedure will be repeated until all samples are collected.

Should MicroWell® installation prove impractical, boreholes will be advanced using conventional hollow stem auger drilling methods. In this instance, the lead auger will have a screened section through which groundwater will flow. Once the sample is collected, the augers will be advanced further for collection at the next sample depth. This procedure will be repeated until all samples are collected within the borehole.

All Geoprobe®, MicroWell®, or Waterloo Profiler® holes will be sealed with grout from the bottom up after completion of sampling at each location. A PID, explosimeter, and a RAM will be used on a continuous basis to monitor these activities.

#### Groundwater Pre-Sampling and Borehole Sampling

Appendix I presents the protocol for groundwater sampling activities.

### 5.6.2 Soil

#### 5.6.2.1 Surface Soil Samples

#### Rationale

Background soil samples will be collected at three locations east of the study area as generally shown in Figure 4. Samples will be collected from a depth of 0 to 0.5 feet bgs. All three surface soil samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Figure 4 displays the approximate background surface soil sample locations for Area 2. Sample locations will be selected in the field with concurrence of USEPA Region V or its designee.

Table 1 presents the analytical methods. A sample and analysis summary for the background soil sampling is presented in Table 11.

#### Field Procedure

Surface soil samples will be discrete. A discrete sample represents a single location in the soil column. Hand augers, disposable scoops, hand trowels, or shovels are used to collect these samples.

Refer to Appendix C for standard waste and soil sampling methods.

#### 5.6.2.2 Subsurface Soil Samples

**Rationale**

Subsurface background soil samples will be collected at the same three locations used for the surface soils as discussed in Section 5.6.2.1. Samples will be collected from a depth of 0.5 to 6 feet. The subsurface soil samples will be analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxin, and metals.

Table 1 presents the analytical methods. A sample and analysis summary for the background soil sampling in presented in Table 11a and Table 11b.

**Field Procedure**

The subsurface background soil samples will be collected in the same manner as the fill area subsurface soil and waste samples.

Refer to Appendix C for the appropriate subsurface soil sampling procedure.

## 5.7 AREA 2 GROUNDWATER FLOW DIRECTION AND FLOW RATE

### 5.7.1 Alluvial Aquifer – Piezometer Clusters

#### 5.7.1.1 Water Levels

Nine piezometer clusters will be installed in the study area to define groundwater flow direction. Three piezometer clusters will be installed at the upgradient portion of the study area, adjacent to Mississippi Avenue (Route 3). Three piezometer clusters will be installed midway between the Mississippi River and Route 3. The third group of three piezometer clusters will be installed at the downgradient end of the study area adjacent to the Mississippi River. Each piezometer cluster will consist of three small-diameter (1-inch) wells. In each cluster, one piezometer will be completed in the shallow portion of the aquifer, one piezometer will be completed in the intermediate portion of the aquifer, and one piezometer will be completed in the deep portion of the aquifer.

Figure 4 shows the approximate piezometer locations for Area 2. Piezometer locations will be selected in the field with concurrence of USEPA Region V or its designee.

Water levels will be measured quarterly for one year in each piezometer. They will be used to prepare water-level elevation maps, which show seasonal changes in groundwater level and flow direction.

#### Piezometer Installation

1. Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive 2-1/4-inch probe rods down to the desired depth (e.g., shallow, intermediate, or deep portion of the aquifer).
2. Soil samples will be collected in the nine piezometers installed in the deep portion of the aquifer. Samples are to be collected every 5 feet and at every change in formation. These samples will be continuously collected during advancement of the boring.
3. For installation of the nine deep borings, the Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depth. Continuous soil samples will be collected. Between each sample collection, the sampler will be retrieved to the surface and the soil samples removed from the disposable acetate liner within the sampler.
4. The piezometers will be constructed of 1-inch diameter PVC (schedule 40) riser pipe and screen. A sand filter pack will not be installed in any of the piezometers.
5. The nine piezometers to be completed in the shallow portion of the aquifer will be constructed such that the water table intersects the screen. Thus, a screen length of approximately 10 feet will be required for these nine piezometers. The screens of the intermediate and deep piezometers will be completely submerged; therefore, it is not necessary that they have a length of 10 feet.
6. The piezometer installation will be completed with either bentonite or concrete.
7. The top of the well risers and the ground surface will be surveyed for elevation and horizontal control.
8. Piezometer installation details will be documented on a test boring log (Appendix B) and in the field notebook.

The piezometers will generally be installed according to the typical construction diagrams in Appendix E. They will also be constructed according to the standard procedures described in Appendix E, with the exception of the following:

- The screen will be installed such that its midpoint approximately intersects the groundwater table in the shallow piezometers.
- The piezometers will not have a filter pack, bentonite seal, or bentonite/cement grout.
- They will not have protective casings.
- The surface installation will be completed with either bentonite or cement.

**Water Level Measurements**

Prior to initiating groundwater sampling, water elevations will be measured in the well. Refer to Appendix I for well gauging procedures.

#### 5.7.1.2 Geotechnical Samples

Geotechnical samples will be collected in the nine, deep piezometer borings. These samples will be collected every 5 feet and at every change in formation. The geotechnical samples will be tested for:

- Grain size
- Particle size distribution
- Porosity
- Bulk density
- Specific gravity
- Moisture content
- pH
- Total organic carbon.

As described earlier in this section (with piezometer installation) a large bore (MacroCore®) soil sampler, using clear acetate liners, will be hydraulically pushed to collect soil samples at the specified depths. Each collected sample will be placed into a labeled, plastic, wide-mouth container and sealed The MacroCore® sampler will collect approximately 1300 mL of material, which is sufficient for grain size analysis. Should larger (large gravel to cobble) size materials be encountered, additional core samples will be obtained and placed into additional containers. Collected samples will be placed into plastic coolers or corrugated boxes for shipment. Chain-of-custody procedures will be followed in order to track samples.

Table 12 presents a sample and analysis summary for grain size analysis.

#### 5.7.1.3 <u>Slug Tests</u>

**Rationale**

Falling and rising head slug tests will be performed on each of the 27 piezometers installed in Area 2. A slug of known volume and in-well, short-time interval, automatic water-level recorders will be used. Aquifer hydraulic conductivity will be calculated for each piezometer using the falling head and rising head slug test data. Groundwater flow rates will be determined by using measured groundwater gradients and calculated aquifer hydraulic conductivities.

**QA/QC Procedures**

QA/QC procedures will consist of equipment test checks.

**Field Procedure**

Appendix K presents the field protocols for the completion of *in situ* hydraulic conductivity tests.

The field sampling team will maintain a set of field logbooks. Forms that will be used include: chain-of-custody, test boring log, and groundwater sampling log, slug test, field log, and air sampling data sheets. The appendices contain copies of these forms.

The field logbooks will contain tabulated results of field measurements and documentation of field instrument calibration activities. The field logbooks will also record the following:

- Personnel conducting the site activities, their arrival and departure times and their destination at the site
- Incidents and unusual activities that occur on the site such as, but not limited to, accidents, breaches of security, injuries, equipment failures, or weather related problems
- Changes to the FSP and the HASP
- Daily information such as:
  - Work accomplished and the current site status
  - Equipment calibrations, repairs and results
  - Site work zones.

In the field sampler's individual bound field logbook, samplers will note, with permanent ink, meteorological data, equipment employed for sample collection, calculations, information regarding collection of QA/QC samples, and any observations. All entries will be signed and dated, and any entry, which is to be deleted will have a single cross out which is signed and dated. The following sampling-related information will be recorded in the field logbook by the field sampling team:

- Sample number
- Project identification
- Sampling location
- Required analysis
- Date and time of sample collection
- Type and matrix of sample
- Sampling technique

- Preservative used, if applicable
- Sampling conditions
- Observations
- Initials of the sampler.

Field data documentation procedures will be minimal in scope. Only direct reading instrumentation will be employed in the field. The use of pH, conductivity, turbidity meters, a photoionization detector (PID); a real time aerosol monitor (RAM), and thermometers will generate some measurements directly read from the meters, following calibration by the respective manufacturer's recommendations. Such data will be written into field logbooks immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed, and dated by the field member. Errors will be corrected in a space adjacent to the original entry. Later, when the results forms are filled out, the URS Field Leader will proofread the forms to assess whether transcription errors have been made.

Photographic records will be developed through the use of digital photographs, showing pre-sampling and post-sampling conditions at each site.

## 6.1 SAMPLE DOCUMENTATION

### 6.1.1 Sample Identification System

The sample identification system will involve the following:

- Soil gas survey data will be labeled SG-P-1 where "SG" denotes soil gas survey, "P" is the site designations, and "1" denotes a sequential sample number.
- Field soil screening by GC/MS will be labeled GCMS-Q-1 where "GCMS" denotes a field screening sample by GC/MS, "Q" is the site designation and "1" denotes a sequential sample number.
- Field soil screening data by XRF will be labeled XRF-Q-1 where "XRF" denotes a field screening sample by XRF, "Q" is the site designation and "1" denotes a sequential sample number.

- Waste samples will be labeled WASTE-P-__FT where "WASTE" denotes a waste sample, "P" is the site designation, and "__FT" indicates sample depth, which is filled in by the sampler.
- Leachate samples will be labeled LEACH-P-1 where "LEACH" denotes a leachate sample, "P" is the site designation, and "1" denotes a subsequent sample number.
- Alluvial aquifer samples will be labeled AA-P-S1-__FT where "AA" denotes an alluvial aquifer sample, "P" is the site designation, "S1" is the sequentially numbered sampling station, and "__FT" indicates sample depth, which is filled in by the sampler.
- Bedrock groundwater samples will be labeled BR-1 and BR-2 where "BR" denotes a bedrock groundwater sample and "1" and "2" denote sequential numbers that correspond to the monitoring well ID.
- Background groundwater samples will be labeled BAA-S1-__FT where "BAA" denotes a background alluvial aquifer sample, "S1" is the sequentially number sampling station, and "__FT" indicates sample depth.
- Piezometer soil samples will be labeled PIEZ-S1-__FT where "PIEZ" denotes a piezometer soil sample, S1 is the sequentially number sampling station, and "__FT" indicates sample depth.
- Soil samples will be labeled SOIL-P-S1-__FT where "SOIL" denotes a soil sample, "P" is the site designation, "S1" is the sequentially numbered sampling station, and "__FT" indicates sample depth.
- Background soil samples will be labeled BS-S1-__FT where "BS" denotes a background soil sample, "S1" is the sequentially numbered sampling station, and "__FT" indicated sample depth, which is filled in by the sampler.
- Air samples will be labeled AIR-P-V-1, AIR-P-S-1, or AIR-P-M-1 where "AIR" denotes an air sample, "P" is the site designation, "V", "S", "P", "H", "C", "D", or "M" designate a VOC, SVOC, pesticide, herbicide, PCB, dioxin, or metals sample, respectively, and "1" denotes a sequential sample number.
- "MS/MSD" or "DUP" at the end of a sample identification will indicate a matrix spike/matrix spike duplicate/spike duplicate or a duplicate sample, respectively.

- Stormwater samples will be labeled STORM-P-1 where "STORM" denotes stormwater, "P" is the site designation, and "1" denotes a sequential sample number.
- Seep samples will be labeled SEEP-Q-1 where "SEEP" denotes a seep sample, "Q" is the site designation, and "1" denotes a sequential sample number.
- Off-site incineration pilot test samples will be labeled WI-P-1 where "WI" denotes a waste sample for off-site incineration testing, "P" is the site designation, and "1" denotes a sequential sample number.
- Off-site disposal pilot test samples will be labeled DISPOSE-P-1 where "DISPOSE" denotes a waste number sample for off-site disposal testing, "P" is the site designation, and "1" denotes a sequential sample number
- On-site thermal desorption pilot test samples will be labeled TD-P-1 where "TD" denotes a waste sample for on-site thermal desorption testing, "P" is the site designation, and "1" denotes a sequential sample number.
- On-site physical/chemical leachate treatment pilot test samples will be labeled PCHEM-P-1 where "PCHEM" denotes a leachate sample for on-site physical/chemical testing, "P" is the site designation, and "1" denotes a sequential sample number.
- Off-site biological leachate pilot test samples will be labeled BIO-P-1 where "BIO" denotes a leachate sample for off-site biological testing, "P" is the site designation, and "1" denotes a sequential sample number.

### 6.1.2 Sample Labels

For proper identification in the field and proper tracking by the analytical laboratory, samples will be labeled in a clear and consistent fashion. Sample labels will be waterproof, or sample containers will be sealed in plastic bags. Field personnel will maintain a sampling log sheet containing information sufficient to allow reconstruction of the sample collection and handling procedures at a later time.

A completed sample label will be attached to each investigative or QC sample. The following will be recorded with permanent ink on sample labels by the field sampling team:

- Project name and number
- Sample number identification

- Initials of sampler
- Sampling location (if not already encoded in the sample number)
- Required analysis
- Date and time of sample collection
- Space for laboratory sample number (only on the sample tag)
- Preservative used, if applicable.

### 6.1.3 Chain-of-Custody Records

Chain-of-custody procedures will be instituted and followed throughout the sampling activities Samples are physical evidence and will be handled according to strict chain-of-custody protocols. The field sampler is personally responsible for the care and custody of the sample until transferred. For proper identification in the field and proper tracking by the analytical laboratory, samples will be labeled in a clear and consistent fashion.

The following information will be recorded with permanent ink on the chain-of-custody by the field sampling team:

- Project identification and number
- Sample description/location
- Required analysis
- Date and time of sample collection
- Type and matrix of sample
- Number of sample containers
- Analysis requested/comments
- Sampler signature/date/time
- Air bill number.

The laboratory will assign a number for each sample upon receipt. That sample number will be placed on the sample label. The label will be attached to the sample container. A chain-of-custody document providing all information, signatures, dates, and other information, as required on the example chain-of-custody form in Appendix C will be completed by the field sampler and provided for each sample cooler. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the chain-of-custody. The field sampler will sign the chain-of-custody form when relinquishing custody, make a copy to keep with the field logbook, and include the original form in an air-tight plastic bag in the sample cooler with the associated samples.

## 6.2 FIELD ANALYTICAL RECORDS

Field analytical records will consist of gas chromatograms from the field gas chromatograph used in the soil gas survey, and the field GC/MS screening of soil samples, XRF readings from the field screening of soil samples, and field logbook entries for field instruments. Chromatograms will be taped into an analytical notebook. In addition to information printed on the chromatograms, field notes will be added as appropriate information detailed on each chromatogram will include:

- Sample number identification
- Initials of sampler
- Sampling location (if not already encoded in the sample number)
- Required analysis
- Date and time of sample collection
- Date and time of analysis
- Instrument name
- Column and detector type
- Carrier gas and flowrate
- Backflush time
- Injection volume
- Gain setting.

Only direct reading instrumentation will be employed in the field. The use of pH, conductivity; and turbidity meters, a photoionization detector (PID), a real time aerosol monitor (RAM), and thermometers will generate some measurements directly read from the meters following calibration by the respective manufacturer's recommendations. Such data will be written into field logbooks immediately after measurements are taken. Calibration records will also be recorded in the logbooks.

## 6.3 DATA MANAGEMENT AND RETENTION

The field data and documentation, as described in this section, will become a part of the final evidence file. The final evidence file will be the central repository for all documents which constitute evidence relevant to sampling and analysis activities as described in this FSP and the QAPP. URS is the custodian of the evidence file and maintains the contents of evidence files for the site, including all relevant records, logs, field logbooks, pictures, subcontractor reports, data reviews, and the database management system.

Upon completion of the analyses, the URS QAO will begin assimilating the field and laboratory notes. In this way, the file for the samples will be generated. The final file for the samples will be stored at URS and will consist of the following:

- Laboratory data packages, including summary and raw data from the analysis of environmental and QC samples, chromatograms, mass spectra, calibration data, work sheets, and sample preparation notebooks
- Chain-of-custody records
- Data validation reports.

The following documentation will supplement the chain-of-custody records:

- Field logbooks and data
- Field collection report
- Photographs and drawings
- Progress and QA reports
- Contractor and subcontractor reports
- Correspondence.

The evidence file must be maintained in a secured, limited access area until all submittals for the project have been reviewed and approved, and for a minimum of six years-past the submittal date of the final report.

# SECTIONSEVEN Personal Protective Equipment

Personal protective equipment (PPE) requirements for each level of protection for URS personnel are described in the HASP prepared for these field activities.

## 7.1. PROTECTIVE EQUIPMENT SELECTION

Initial levels of PPE will be as shown in the following table.

| Activity | Level B | Level C | Modified Level D | Level D |
|---|---|---|---|---|
| Trenching | | Observation | | |
| Soil Gas Sampling | | Initial | | |
| Magnetometer Survey | | | Initial | |
| Installation of Soil Borings and collection of cuttings | | Initial | | |
| Installation and sampling of groundwater wells | | Initial | | |
| Surface and subsurface soil sampling | | Initial | | |
| Air sampling | | | Initial | |

# SECTIONEIGHT Sample Packaging and Shipping

A completed sample label will be attached to each investigative or QC sample and the sample placed in a shipping container. Information to be recorded on sample labels is described in Section 6.1.2. Information to be recorded on chain-of-custody forms is described in Section 6.1.3. The sample identification system used in the field is described in Section 6.1.1.

Sampling containers will be packed in such a way as to help prevent breakage and cross-contamination. Samples will be shipped in coolers, each containing a chain-of-custody form and ice and ice packs to maintain inside temperature at approximately 4°C. Sample coolers will then be sealed between the lid and sides of the cooler with a custody seal prior to shipment. The custody seal will be an adhesive-backed tape that easily rips if it is disturbed. Samples will be shipped to the laboratory by common overnight carrier or will be delivered by URS. The field sampling team will send sample coolers to Savannah Labs and/or Lancaster Labs. For samples collected for dioxin and dibenzofuran analysis, samples will be sent to Triangle Labs.

Samples will not be sent to another laboratory without the permission of USEPA Region V. Sample transportation will comply with U.S. Department of Transportation and IICAO/IATA (1999) regulations. Special sampling packing provisions will be made for samples requiring additional protection.

Samples will remain in the custody of the sampler until transfer of custody is completed. Transfer consists of:

- Delivery of samples to the laboratory sample custodian
- Signature of the laboratory sample custodian on the chain-of-custody document as receiving the samples, and signature of sampler, as relinquishing the samples.

If a carrier is used to take samples between the sampler and the laboratory, a copy of the air bill must be attached to the chain-of-custody to maintain proof of custody.

# SECTIONNINE Investigation-Derived Wastes

Sampling activities will occur in widely-separated locations. Therefore, personnel and equipment decontamination will be accomplished at each sampling area using temporary facilities. Section 9 of the HASP describes personnel and monitoring equipment decontamination procedures and supplies. PPE, disposable sampling equipment, cuttings, purge waters, and field decontamination wastes will be collected at the point of generation and stored in temporary containers. PPE, solids, and liquids will be consolidated in separate bulk containers at a central area. The sampling procedures have been developed to minimize the quantity of waste generated. Additional activity-specific information on disposal of investigation-derived wastes is contained in Section 5 of this FSP.

The performance audit is an independent check to evaluate the quality of data being generated. The system audit is an on-site review and evaluation of the quality control practices, sampling procedures, and documentation procedures.

At the discretion of the URS PM, performance and system audits of field activities will be conducted to verify that sampling and analyses are performed in accordance with the procedures established in this FSP and the QAPP. The audits of field activities include two independent parts: internal and external audits.

The internal audits will be performed by the URS QAO. The external audits will be performed by USEPA Region V.

## 10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

### 10.1.1 Internal Field Audits

*Internal field audit responsibilities.* Internal audits of field activities, including sampling and field measurements will be conducted by the URS QAO or his designee.

*Internal field audit frequency.* These audits will verify that all established procedures are being followed. Internal field audits will be conducted at least once at the beginning of the site sample collection activities and annually thereafter.

*Internal field audit procedures.* The audits will include examination of field sampling records, field instrumentation operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, and other elements of the field program. Follow up audits will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the project. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. The areas of concern in a field audit include:

- Sampling procedures
- Decontamination of sampling equipment, if applicable
- Chain-of-custody procedures
- Standard operating procedures

- Proper documentation in field notebooks
- Subcontractor procedures.

### 10.1.2 External Field Audits

*External field audit responsibilities.* External field audits may be conducted by USEPA Region V.

*External field audit frequency.* External field audits may be conducted at any time during the field operations. These audits may or may not be announced and are at the discretion of USEPA Region V.

*Overview of the external field audit process.* External field audits will be conducted according to the field activity information presented in this FSP and the QAPP.

# SECTIONELEVEN Corrective Action

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. Corrective action proposed and implemented will be documented in the regular quality assurance reports to management. Corrective action should only be implemented after approval by the URS PM or the URS Field Leader. If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be developed and implemented at the time the problem is identified. The person who identifies the problem will be responsible for notifying the URS PM, who in turn will notify the URS PO. Implementation of corrective action will be confirmed in writing through the same channels. Nonconformance with the established quality control procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP.

## 11.1 FIELD CORRECTIVE ACTION

Corrective action in the field can be needed when the sample network is changed (i.e., more or less samples, sampling location changes, and related modifications) or sampling procedures and/or field analytical procedures require modification due to unexpected conditions. Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the URS Field Leader. The URS Field Leader will be responsible for assessing the suspected problems in consultation with the URS PM and assessing the potential for the situation to impact the quality of the data. If the situation warrants reportable nonconformance requiring corrective action, a nonconformance report will be initiated by the URS PM.

The URS PM will be responsible for seeing that corrective actions for nonconformance are initiated by:

- Evaluating reported nonconformances
- Controlling additional work on nonconforming items
- Establishing disposition or action to be taken

- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Verifying nonconformance reports are included in the final site documentation in project files.

If appropriate, the URS Field Leader will verify that no additional work dependent on the nonconforming activity is performed until the corrective actions are completed. Corrective action for field measurements may include:

- Repeat the measurement to check the error
- Check for proper adjustments for ambient conditions, such as temperature
- Check the batteries
- Recalibration
- Check the calibration
- Replace the instrument or measurement devices
- Stop work (if necessary).

The URS Field Leader is responsible for site activities. In this role, the URS Field Leader, at times, is required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the URS Field Leader of the anticipated change and implements the necessary changes after obtaining the approval of the URS Field Leader. The change in the program will be documented on the field change request (FCR) that will be signed by the initiators and the URS Field Leader. The FCR for each document will be numbered serially as required. The FCR will be attached to the file copy of the affected document. The URS Field Leader must approve the change in writing or verbally prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices.

The URS Field Leader is responsible for controlling, tracking, and implementing identified changes. Reports on changes will be distributed to affected parties, which includes USEPA Region V.

# SECTIONTWELVE References

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URS Corporation, 2001. *Health and Safety Plan, Sauget Area II Support Sampling Project, Sauget and Cahokia, Illinois. Volume 2C.*

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U.S. Environmental Protection Agency (USEPA). 1988. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air,* EPA/600/4-89/017, June 1988, Research Triangle Park, NC.

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# Tables

**Table 1**
**Analytical Methods Used for Fill Area Samples**
**Sauget Area 2 Support Sampling Plan, Volume 2A**

## Area 2 Analyses

| Analyte | Method |
|---|---|
| VOCs | 8260B |
| SVOCs | 8270C |
| Pesticides | 8081A |
| Herbicides | 8151A |
| PCBs | 680 |
| Metals | 6010B |
| Dioxin | 8280 (water) / 8290 (solids) |

**Geochemical Parameters**

| |
|---|
| Oxidation Reduction Potential (ORP) |
| Dissolved Oxygen (DO) |
| Ferrous Iron |
| Manganese |
| Nitrate |
| Sulfate |
| Alkalinity |
| Methane |
| Carbon Dioxide |

# Table 2
## Fill Areas Soil Gas Survey - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Site | Matrix | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time |
|---|---|---|---|---|---|---|---|---|---|---|
| O | Soil Gas | VOC-Field GC 3810[1] | 24 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| P | Soil Gas | VOC-Field GC 3810[1] | 75 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Q | Soil Gas | VOC-Field GC 3810[1] | 238 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| R | Soil Gas | VOC-Field GC 3810[1] | 30 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| S | Soil Gas | VOC-Field GC 3810[1] | 5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total Number of Samples | | | 372 | | | | | | | |

[1] Static headspace analysis, closely parallels USEPA Method 3810

## Table 3
## Fill Areas Waste and Leachate Sampling - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site (waste, leachate) | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / *Analysis* |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | VOCs | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | One per sample cooler containing VOC analysis (3, 1) | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | Transferred to soil container or analyzed 48 hours from collection; For TCLP VOCs, 14 days from collection to TCLP extract generation, 14 days from TCLP extraction to analysis |
| Q | VOCs | 16 , 2 | | | | | | | |
| O,P,R,S | SVOCs | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP-SVOCs, 14 days from collection to TCLP extract generation, 7 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | SVOCs | 16 , 2 | | | | | | | |

**Table 3**
**Fill Areas Waste and Leachate Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site (waste, leachate) | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Pesticides | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | Pesticides | 16 , 2 | | | | | | | |
| O,P,R,S | Herbicides | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | Herbicides | 16 , 2 | | | | | | | |

**Table 3**
**Fill Areas Waste and Leachate Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site (waste, leachate) | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | PCBs | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | NA | 500 mL wide mouth glass container | 4oC | 14 days from collection to extraction; 40 days from extraction to analysis |
| Q | PCBs | 16 , 2 | | | | | | | |
| O,P,R,S | Metals | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | NA | 4 ounce wide mouth polyethylene or fluorocarbon (TFE or PFA) container | 4°C | 180 days from collection; For TCLP, 180 days from collection to TCLP extract generation, 180 days from extraction to analysis |
| Q | Metals | 16 , 2 | | | | | | | |

**Table 3**
**Fill Areas Waste and Leachate Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site (waste, leachate) | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Dioxin | 8 , 1 | One per 10, or fraction of 10, samples collected (5, 1) | One per 10, or fraction of 10, samples (5, 1) | One per 20, or fraction of 20, samples collected (3, 1) | NA | 100 grams in 4 oz. Amber glass jar with Teflon™ lined lid | 4°C | 30 days from collection to extraction, 45 days from extraction to analysis |
| Q | Dioxin | 16 , 2 | | | | | | | |
| Total Number of Samples | | 336 , 42 | (35, 7) | (35, 7) | (21, 7) | (3) | | | |

* (x) Estimated number, criteria presented shall be used ot determine actual numbers.

**Table 4**
**Fill Areas Alluvial Groundwater Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | VOCs | 39 | One per 10, or fraction of 10, samples collected (24) | One per 10, or fraction of 10, samples (24) | One per 20, or fraction of 20, samples collected (12) | One per sample cooler containing VOC analysis (12) | 3-40 mL glass vials with Teflon™-lined septum caps | 4°C HCl to pH<2 FC | 14 days from collection |
| Q | VOCs | 78 | | | | | | | |
| O,P,R,S | SVOCs | 39 | One per 10, or fraction of 10, samples collected (24) | One per 10, or fraction of 10, samples (24) | One per 20, or fraction of 20, samples collected (12) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | SVOCs | 78 | | | | | | | |
| O,P,R,S | Pesticides | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | Pesticides | 24 | | | | | | | |

**Table 4**
**Fill Areas Alluvial Groundwater Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| *Site* | *Parameters* | *Number of Environmental Samples per Site* | *Number of Field Blanks / Equipment Blanks* | *Number of Field Duplicates* | *Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates* | *Number of Trip Blanks* | *Sample Containers (number, size, type)* | *Preservation* | *Holding Time Extraction / Analysis* |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Herbicides | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | Herbicides | 24 | | | | | | | |
| O,P,R,S | PCBs | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | PCBs | 24 | | | | | | | |
| O,P,R,S | Metals | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| Q | Metals | 24 | | | | | | | |

Table 4
Fill Areas Alluvial Groundwater Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Dioxin | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 30 days from collection to extraction, 45 days from extraction to analysis |
| Q | Dioxin | 6 | | | | | | | |
| O,P,R,S | ORP | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 250 mL plastic container | 4°C | As soon as possible |
| Q | ORP | 24 | | | | | | | |
| O,P,R,S | DO | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 100 mL plastic container | 4°C | As soon as possible |
| Q | DO | 24 | | | | | | | |

**Table 4**
**Fill Areas Alluvial Groundwater Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Ferrous Iron | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 250 mL plastic container | 4°C HCl to pH<2 | As soon as possible |
| Q | Ferrous Iron | 24 | | | | | | | |
| O,P,R,S | Manganese | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| Q | Manganese | 24 | | | | | | | |
| O,P,R,S | Nitrate | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 250 mL plastic container | 4°C | 48 hours |
| Q | Nitrate | 24 | | | | | | | |

Table 4
Fill Areas Alluvial Groundwater Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Sulfate | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 250 mL plastic container | 4°C | 28 days |
| Q | Sulfate | 24 | | | | | | | |
| O,P,R,S | Alkalinity | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 250 mL plastic container | 4°C | 14 days from collection |
| Q | Alkalinity | 24 | | | | | | | |
| O,P,R,S | Methane | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 40 mL VOA vial | 4°C | 14 days |
| Q | Methane | 24 | | | | | | | |

**Table 4**
**Fill Areas Alluvial Groundwater Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Carbon Dioxide | 12 | One per 10, or fraction of 10, samples collected (8) | One per 10, or fraction of 10, samples (8) | One per 20, or fraction of 20, samples collected (4) | NA | 40 ml. VOA vial | 4°C | 14 days |
| Q | Carbon Dioxide | 24 | | | | | | | |
| Total Number of Samples | | 1422 | (154) | (154) | (77) | (12) | | | |

FC If free chlorine is present in samples, it must be removed by the appropriate addition of $Na_2S_2O_3$.
* (x) Estimated number, criteria presented shall be used to determine actual numbers.

## Table 5
## Fill Areas Bedrock Well Sampling - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | VOCs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | One per sample cooler containing VOC analysis (1) | 3-40 mL glass vials with Teflon™-lined septum caps | 4°C HCl to pH<2 FC | 14 days from collection |
| Q | VOCs | 2 | | | | | | | |
| O,P,R,S | SVOCs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | SVOCs | 2 | | | | | | | |
| O,P,R,S | Pesticides | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | Pesticides | 2 | | | | | | | |

**Table 5**
**Fill Areas Bedrock Well Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Herbicides | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | Herbicides | 2 | | | | | | | |
| O,P,R,S | PCBs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | PCBs | 2 | | | | | | | |
| O,P,R,S | Metals | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| Q | Metals | 2 | | | | | | | |

Table 5
**Fill Areas Bedrock Well Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Dioxin | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 30 days from collection to extraction, 45 days from extraction to analysis |
| Q | Dioxin | 2 | | | | | | | |
| O,P,R,S | ORP | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | As soon as possible |
| Q | ORP | 2 | | | | | | | |
| O,P,R,S | DO | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 100 mL plastic container | 4°C | As soon as possible |
| Q | DO | 2 | | | | | | | |

**Table 5**
**Fill Areas Bedrock Well Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Ferrous Iron | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C HCl to pH<2 | As soon as possible |
| Q | Ferrous Iron | 2 | | | | | | | |
| O,P,R,S | Manganese | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| Q | Manganese | 2 | | | | | | | |
| O,P,R,S | Nitrate | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | 48 hours |
| Q | Nitrate | 2 | | | | | | | |

# Table 5
## Fill Areas Bedrock Well Sampling - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Sulfate | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | 28 days |
| Q | Sulfate | 2 | | | | | | | |
| O,P,R,S | Alkalinity | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | 14 days from collection |
| Q | Alkalinity | 2 | | | | | | | |
| O,P,R,S | Methane | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 40 mL VOA vial | 4°C | 14 days |
| Q | Methane | 2 | | | | | | | |

**Table 5**
**Fill Areas Bedrock Well Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Carbon Dioxide | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 40 mL VOA vial | 4°C | 14 days |
| Q | Carbon Dioxide | 2 | | | | | | | |
| Total Number of Samples | | 96 | (16) | (16) | (16) | (1) | | | |

Six samples of each of the following analytes will be collected from the open hole (collected as well is installed): VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and each of the geochemical parameters.
No dioxin samples will be collected from the open hole.
Two samples of each of the analytes will be collected from the cased/screened hole (bedrock groundwater).
* (x) Estimated number, criteria presented shall be used to determine actual numbers.

## Table 6
## Fill Areas Surface Soil Sampling - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | VOCs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | One per sample cooler containing VOC analysis (2) | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | Transferred to soil container or analyzed 48 hours from collection; For TCLP VOCs, 14 days from collection to TCLP extract generation, 14 days from TCLP extraction to analysis |
| Q | VOCs | 11 | | | | | | | |
| O,P,R,S | SVOCs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP-SVOCs, 14 days from collection to TCLP extract generation, 7 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | SVOCs | 11 | | | | | | | |

**Table 6**
**Fill Areas Surface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Pesticides | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | Pesticides | 11 | | | | | | | |
| O,P,R,S | Herbicides | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | Herbicides | 11 | | | | | | | |

Table 6
Fill Areas Surface Soil Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | PCBs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 500 mL wide mouth glass container | 4oC | 14 days from collection to extraction; 40 days from extraction to analysis |
| Q | PCBs | 11 | | | | | | | |
| O,P,R,S | Metals | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 4 ounce wide mouth polyethylene or fluorocarbon (TFE or PFA) container | 4°C | 180 days from collection; For TCLP, 180 days from collection to TCLP extract generation, 180 days from extraction to analysis |
| Q | Metals | 11 | | | | | | | |

**Table 6**
**Fill Areas Surface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Dioxin | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 100 grams in 4 oz. Amber glass jar with Teflon™-lined lid | 4°C | 30 days from collection to extraction, 45 days from extraction to analysis |
| Q | Dioxin | 11 | | | | | | | |
| Total Number of Samples | | 189 | (21) | (21) | (14) | (2) | | | |

* (x) Estimated number, criteria presented shall be used to determine actual numbers.

Table 7
**Fill Areas Subsurface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | VOCs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | One per sample cooler containing VOC analysis (2) | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | Transferred to soil container or analyzed 48 hours from collection; For TCLP VOCs, 14 days from collection to TCLP extract generation, 14 days from TCLP extraction to analysis |
| Q | VOCs | 11 | | | | | | | |
| O,P,R,S | SVOCs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP-SVOCs, 14 days from collection to TCLP extract generation, 7 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | SVOCs | 11 | | | | | | | |

**Table 7**
**Fill Areas Subsurface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Pesticides | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | Pesticides | 11 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| O,P,R,S | Herbicides | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| Q | Herbicides | 11 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 250 mL wide mouth glass container with Teflon™-lined lid | 4°C | 14 days from collection to extraction; 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |

Table 7

**Fill Areas Subsurface Soil Sampling - Sample and Analysis Summary**

**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | PCBs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 500 mL wide mouth glass container | 4oC | 14 days from collection to extraction; 40 days from extraction to analysis |
| Q | PCBs | 11 | | | | | | | |
| O,P,R,S | Metals | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 4 ounce wide mouth polyethylene or fluorocarbon (TFE or PFA) container | 4°C | 180 days from collection; For TCLP, 180 days from collection to TCLP extract generation, 180 days from extraction to analysis |
| Q | Metals | 11 | | | | | | | |

**Table 7**
**Fill Areas Subsurface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Dioxin | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | 100 grams in 4 oz. Amber glass jar with Teflon™-lined lid | 4°C | 30 days from collection to extraction, 45 days from extraction to analysis |
| Q | Dioxin | 11 | | | | | | | |
| Total Number of Samples | | 189 | (21) | (21) | (14) | (2) | | | |

* (x) Estimated number, criteria presented shall be used to determine actual numbers.

Table 8
Air Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| P | VOCs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | One per sample cooler containing VOC analysis (2) | Sample cartridge/filter as described in Method TO1 | 4°C | 7 days from collection or analysis |
| O,R,&S | VOCs | 4 | | | | | | | |
| Q | VOCs | 8 | | | | | | | |
| P | SVOCs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | Sample cartridge/filter as described in Method TO13 | 4°C | 7 days from collection or analysis |
| O,R,&S | SVOCs | 4 | | | | | | | |
| Q | SVOCs | 8 | | | | | | | |

**Table 8**
**Air Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| P | Pesticides | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | Sample cartridge/filter as described in Method TO13 | 4°C | 7 days from collection or analysis |
| O,R,&S | Pesticides | 4 | | | | | | | |
| Q | Pesticides | 8 | | | | | | | |
| P | Herbicides | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | Sample cartridge/filter as described in Method TO13 | 4°C | 7 days from collection or analysis |
| O,R,&S | Herbicides | 4 | | | | | | | |
| Q | Herbicides | 8 | | | | | | | |

**Table 8**
**Air Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| P | PCBs | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | Sample cartridge/filter as described in Method TO13 | 4°C | 7 days from collection or analysis |
| O,R,&S | PCBs | 4 | | | | | | | |
| Q | PCBs | 8 | | | | | | | |
| P | Metals | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | Sample cartridge/filter as described in Method 6010B | 4°C | 7 days from collection or analysis |
| O,R,&S | Metals | 4 | | | | | | | |
| Q | Metals | 8 | | | | | | | |

## Table 8
## Air Sampling - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| P | Dioxin | 4 | One per 10, or fraction of 10, samples collected (3) | One per 10, or fraction of 10, samples (3) | One per 20, or fraction of 20, samples collected (2) | NA | Sample cartridge/filter as described in Method TO9 | 4°C | 7 days from collection or analysis |
| O,R,&S | Dioxin | 4 | | | | | | | |
| Q | Dioxin | 8 | | | | | | | |
| Total Number of Samples | | 112 | (21) | (21) | (14) | (2) | | | |

* (x) Estimated number, criteria presented shall be used to determine actual numbers.

Table 9
**Fill Areas Stormwater Runoff Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | VOCs | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | One per sample cooler containing VOC analysis (1) | 3-40 mL glass vials with Teflon™-lined septum caps | 4°C HCl to pH<2 FC | 14 days from collection |
| Q | VOCs | 6 | | | | | | | |
| O,P,R,S | SVOCs | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | SVOCs | 6 | | | | | | | |
| O,P,R,S | Pesticides | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | Pesticides | 6 | | | | | | | |

**Table 9**
**Fill Areas Stormwater Runoff Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Herbicides | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | Herbicides | 6 | | | | | | | |
| O,P,R,S | PCBs | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| Q | PCBs | 6 | | | | | | | |
| O,P,R,S | Metals | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| Q | Metals | 6 | | | | | | | |

Table 9

**Fill Areas Stormwater Runoff Sampling - Sample and Analysis Summary**

**Sauget Area 2 Field Sampling Plan**

| Site | Parameters | Number of Environmental Samples per Site | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| O,P,R,S | Dioxin | 3 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon$^{TM}$-lined screw caps | 4°C FC | 30 days from collection to extraction, 45 days from extraction to analysis |
| Q | Dioxin | 6 | | | | | | | |
| Total Number of Samples | | 63 | (14) | (14) | (7) | (1) | | | |

* (x) Estimated number, criteria presented shall be used to determine actual numbers.

**Table 10**
**Background Groundwater Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | VOCs | 13 | One per 10, or fraction of 10, samples collected (4) | One per 10, or fraction of 10, samples (4) | One per 20, or fraction of 20, samples collected (2) | One per sample cooler containing VOC analysis (2) | 3-40 mL glass vials with Teflon™-lined septum caps | 4°C HCl to pH<2 FC | 14 days from collection |
| 1,2,3 | SVOCs | 13 | One per 10, or fraction of 10, samples collected (4) | One per 10, or fraction of 10, samples (4) | One per 20, or fraction of 20, samples collected (2) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 7 days from collection to extraction, 40 days from extraction to analysis |
| 1,2,3 | Pesticides | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| 1,2,3 | Herbicides | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 4-one liter amber glass containers with Teflon™-lines screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |

# Table 10
## Background Groundwater Sampling - Sample and Analysis Summary
## Sauget Area 2 Field Sampling Plan

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | PCBs | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C | 7 days from collection to extraction, 40 days from extraction to analysis |
| 1,2,3 | Metals | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| 2 | Dioxin | 3 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 2-one liter amber glass containers with Teflon™-lined screw caps | 4°C FC | 30 days from collection to extraction, 45 days from extraction to analysis |
| 1,2,3 | ORP | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | As soon as possible |

**Table 10**
**Background Groundwater Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | DO | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 100 mL plastic container | 4°C | As soon as possible |
| 1,2,3 | Ferrous Iron | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C HCl to pH<2 | As soon as possible |
| 1,2,3 | Manganese | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 1-250 or 500 mL polyethylene or fluorocarbon (TFE or PFA) container | 4°C $HNO_3$ to pH<2 | 180 days from collection |
| 1,2,3 | Nitrate | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | 48 hours |

Table 10
Background Groundwater Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | Sulfate | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | 28 days |
| 1,2,3 | Alkalinity | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 250 mL plastic container | 4°C | 14 days from collection |
| 1,2,3 | Methane | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 40 mL VOA vial | 4°C | 14 days |
| 1,2,3 | Carbon Dioxide | 4 | One per 10, or fraction of 10, samples collected (2) | One per 10, or fraction of 10, samples (2) | One per 20, or fraction of 20, samples collected (1) | NA | 40 mL VOA vial | 4°C | 14 days |
| Total Number of Samples | | 237 | (35) | (35) | (18) | (2) | | | |

* (x) Estimated nubmer, criteria presented shall be used to determine actual numbers.

Table 11A
Background Surface Soil Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | VOCs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | One per sample cooler containing VOC analysis (1) | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | Transferred to soil container or analyzed 48 hours from collection; For TCLP VOCs, 14 days from collection to TCLP extract generation, 14 days from TCLP extraction to analysis |
| 1,2,3 | SVOCs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis; For TCLP SVOCs, 14 days from collection to TCLP extract generation, 7 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| 1,2,3 | Pesticides | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| 1,2,3 | Herbicides | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |

Table 11A
Background Surface Soil Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | PCBs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis |
| 1,2,3 | Metals | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 180 days from collection; For TCLP, 180 days from collection to TCLP extract generation, 180 days from extraction to analysis |
| 1,2,3 | Dioxin | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 30 days from collection to extraction, 45 days from extraction to analysis |
| Total Number of Samples | | 21 | (7) | (7) | (7) | (1) | | | |

* (x) Estimated number, criteria presented shall be used to determine actual numbers.

**Table 11B**
**Background Subsurface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | VOCs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | One per sample cooler containing VOC analysis (1) | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | Transferred to soil container or analyzed 48 hours from collection; For TCLP VOCs, 14 days from collection to TCLP extract generation, 14 days from TCLP extraction to analysis |
| 1,2,3 | SVOCs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis; For TCLP SVOCs, 14 days from collection to TCLP extract generation, 7 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| 1,2,3 | Pesticides | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |

Table 11B
Background Subsurface Soil Sampling - Sample and Analysis Summary
Sauget Area 2 Field Sampling Plan

| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | Herbicides | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis; For TCLP, 14 days from collection to TCLP extract generation, 14 days from TCLP extract generation to extraction, 40 days from extraction to analysis |
| 1,2,3 | PCBs | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 14 days from collection to extraction, 40 days from extraction to analysis |
| 1,2,3 | Metals | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 180 days from collection; For TCLP, 180 days from collection to TCLP extract generation, 180 days from extraction to analysis |

**Table 11B**
**Background Subsurface Soil Sampling - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

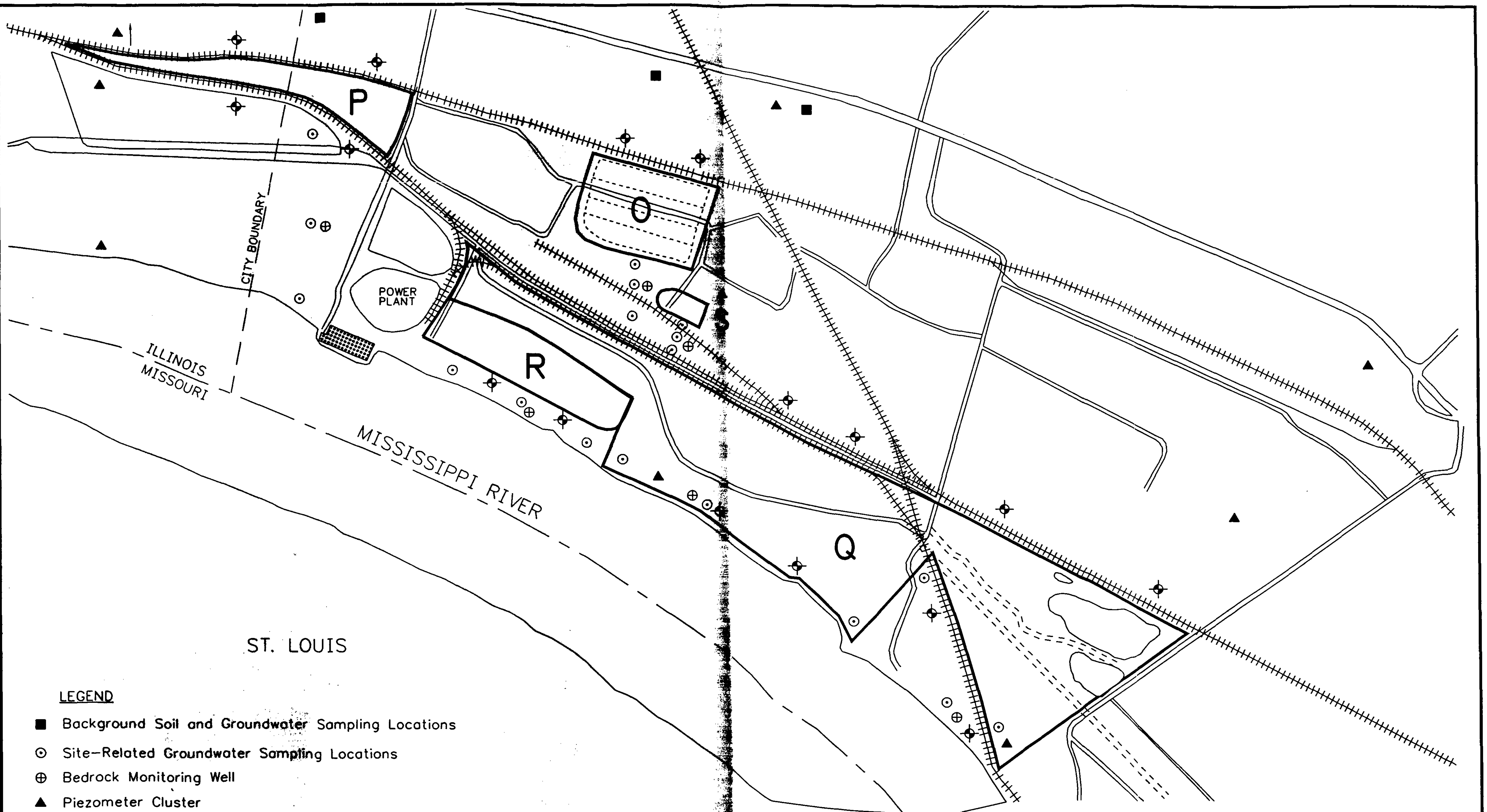
| Station | Parameters | Number of Environmental Samples per Station | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1,2,3 | Dioxin | 1 | One per 10, or fraction of 10, samples collected (1) | One per 10, or fraction of 10, samples (1) | One per 20, or fraction of 20, samples collected (1) | NA | 3-Encore™ samplers (or in accordance with USEPA Method 5035) | 4°C | 30 days from collection to extraction, 45 days from extraction to analysis |
| Total Number of Samples | | 21 | (7) | (7) | (7) | (1) | | | |

Notice there are no dioxin analyses in the subsurface background soil.
* (x) Estimated number, criteria presented shall be used to determine actual numbers.

Table 12
**Fill Areas Soil Grain Size Analysis - Sample and Analysis Summary**
**Sauget Area 2 Field Sampling Plan**

| Deep Piezometer | Parameters | Number of Environmental Samples | Number of Field Blanks / Equipment Blanks | Number of Field Duplicates | Number of Matrix Spike / Matrix Spike Duplicates or Spike Spike Duplicates | Number of Trip Blanks | Sample Containers (number, size, type) | Preservation | Holding Time Extraction / Analysis |
|---|---|---|---|---|---|---|---|---|---|
| #1 - #9 | Grain Size<br>Particle Size<br>Bulk Density<br>Specific Gravity<br>Moisture Content<br>pH<br>TOC | Every 5 feet and every change in formation to bottom of piezometer | One per 10, or fraction of 10, samples collected | One per 10, or fraction of 10, samples | One per 20, or fraction of 20, samples collected | N/A | 4 ounce wide mouth glass container with Teflon™-lined lid;<br>for pH, 100 mL plastic container | 4°C | As soon as possible; for TOC, 28 days from collection |

# Figures




LEGEND

- ■ Background Soil and Groundwater Sampling Locations
- ⊙ Site–Related Groundwater Sampling Locations
- ⊕ Bedrock Monitoring Well
- ▲ Piezometer Cluster
- ⌖ Air Sampling Location

Note: Data from Area 1 background locations will also be considered as background for Area 2

N

0 1000

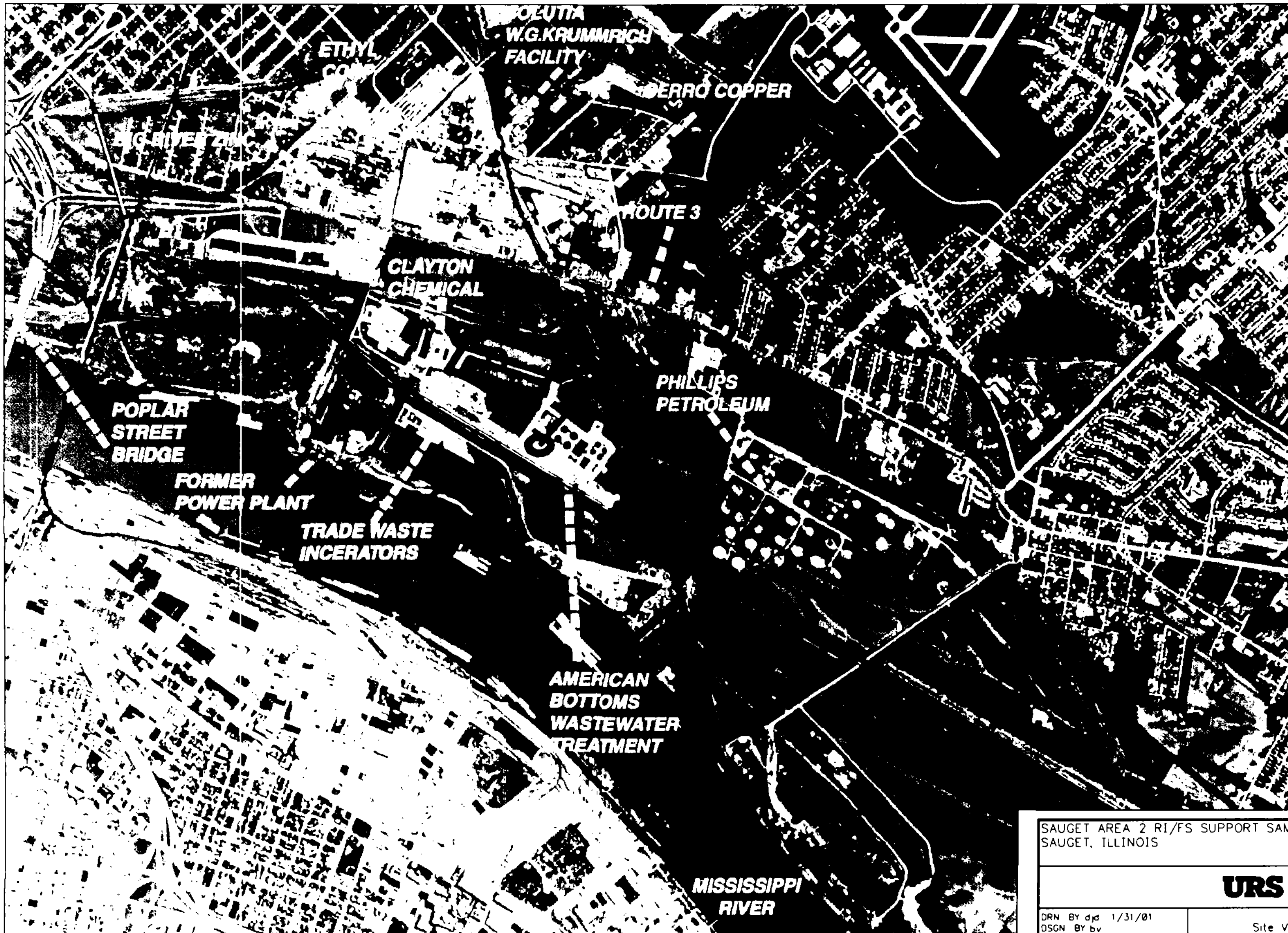
SCALE FEET

| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET ILLINOIS | PROJECT NO.<br>2320010024.02 |
|---|---|

URS

| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Background Soil and Groundwater Piezometer, Groundwater, and Air Sampling Locations | FIG. NO.<br>4 |
|---|---|---|

File: E:\2320010024.00\AREA2 SAMPLE LOCATIONS.DWG Last edited: 05/22/01 @ 4:27 p.m. WC-ST.LOUIS, MO

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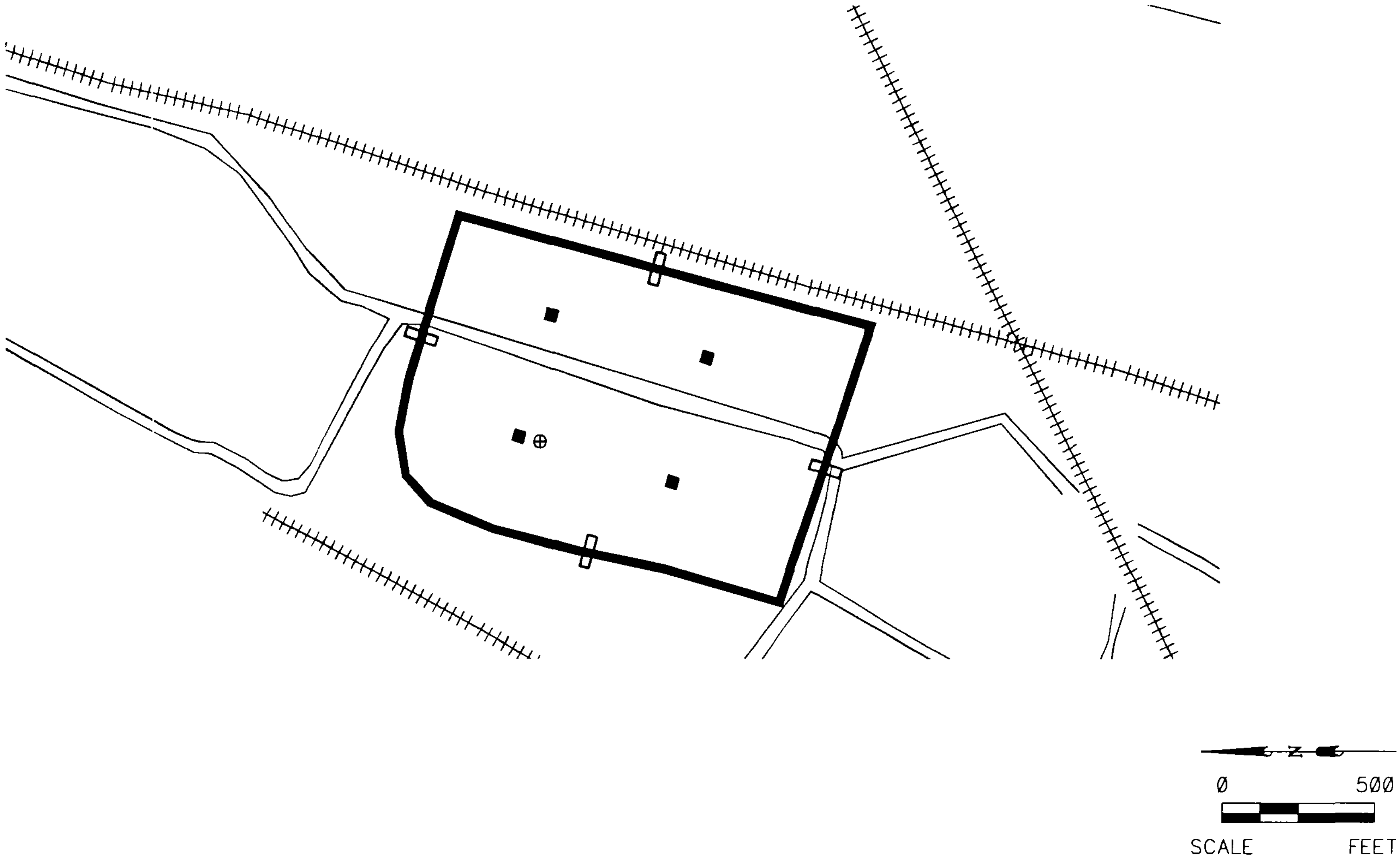
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO<br>2320010024.02 |

**URS**

| | | |
|---|---|---|
| DRN BY djd 1/31/01<br>DSGN BY bv<br>CHKD. BY | Site Vicinity Map | FIG NO<br>1 |

File: E:\2320010024.00\SITE MAP FIG_1.DWG Last edited: 05/29/01 @ 08:09 a.m. WC-ST LOUIS, MO

File: E:\2320010024.00\TEST TRENCH.DWG Last edited: 05/24/01 @ 10:10 a.m. WC-ST.LOUIS, MO




LEGEND

⊕ Leachate Monitoring Wel l

▭ Test Trench (Area Extent of Waste)

■ Waste Characterization Boring

Note: Trench size not to scale; approximate length=20 feet

| | |
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>2320010024.02 |

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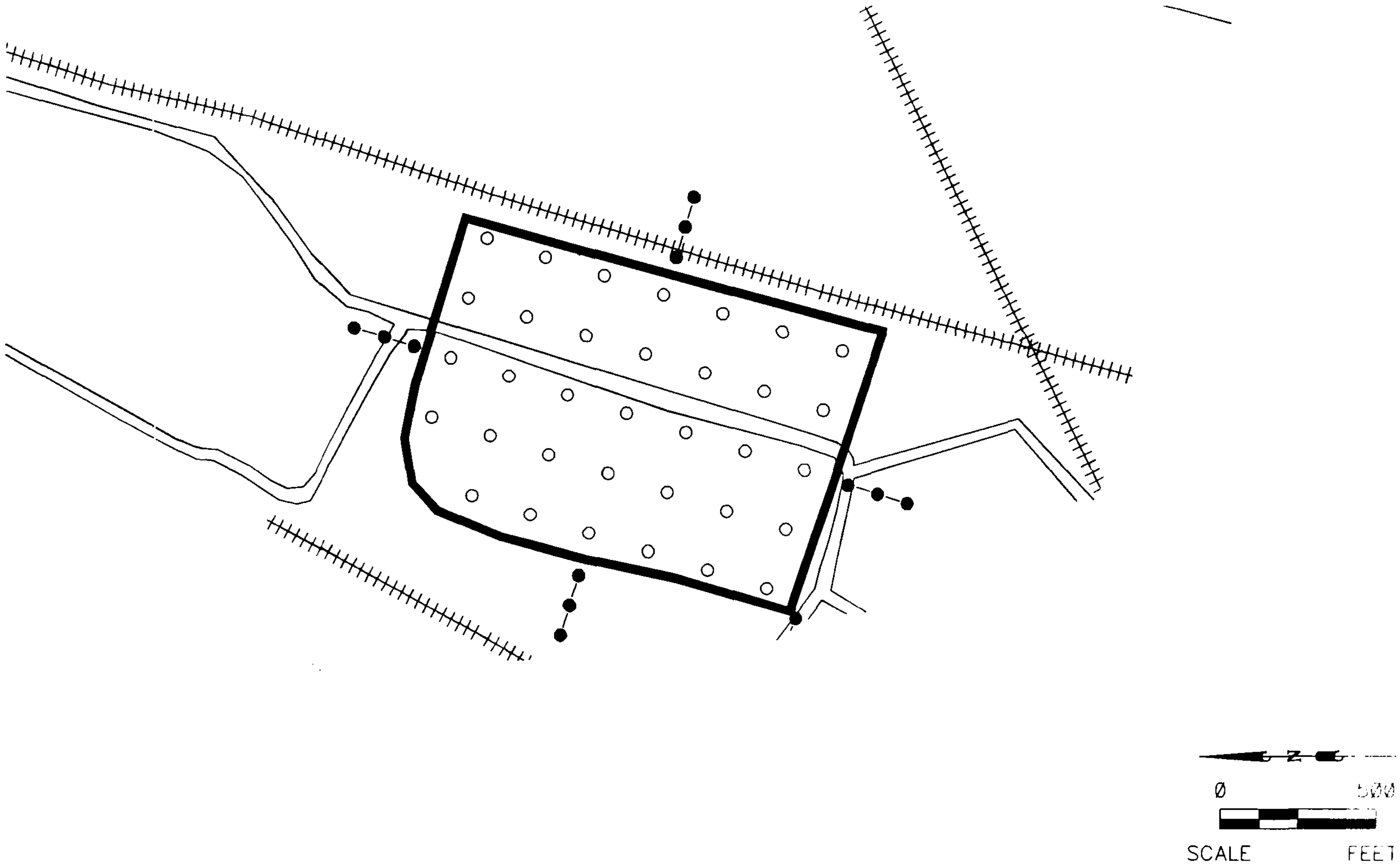
| | | |
|---|---|---|
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site O Waste, Soil, and Leachate Sampling Locations | FIG. NO.<br>2 |

File: E:\2320010024.00\SOIL_GAS.DWG Last edited: 05/24/01 @ 10:15 a.m. WC-ST.LOUIS, MO




SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN
SAUGET, ILLINOIS

PROJECT NO. 2320010024.02

URS

LEGEND

○ Soil Gas Survey Locations

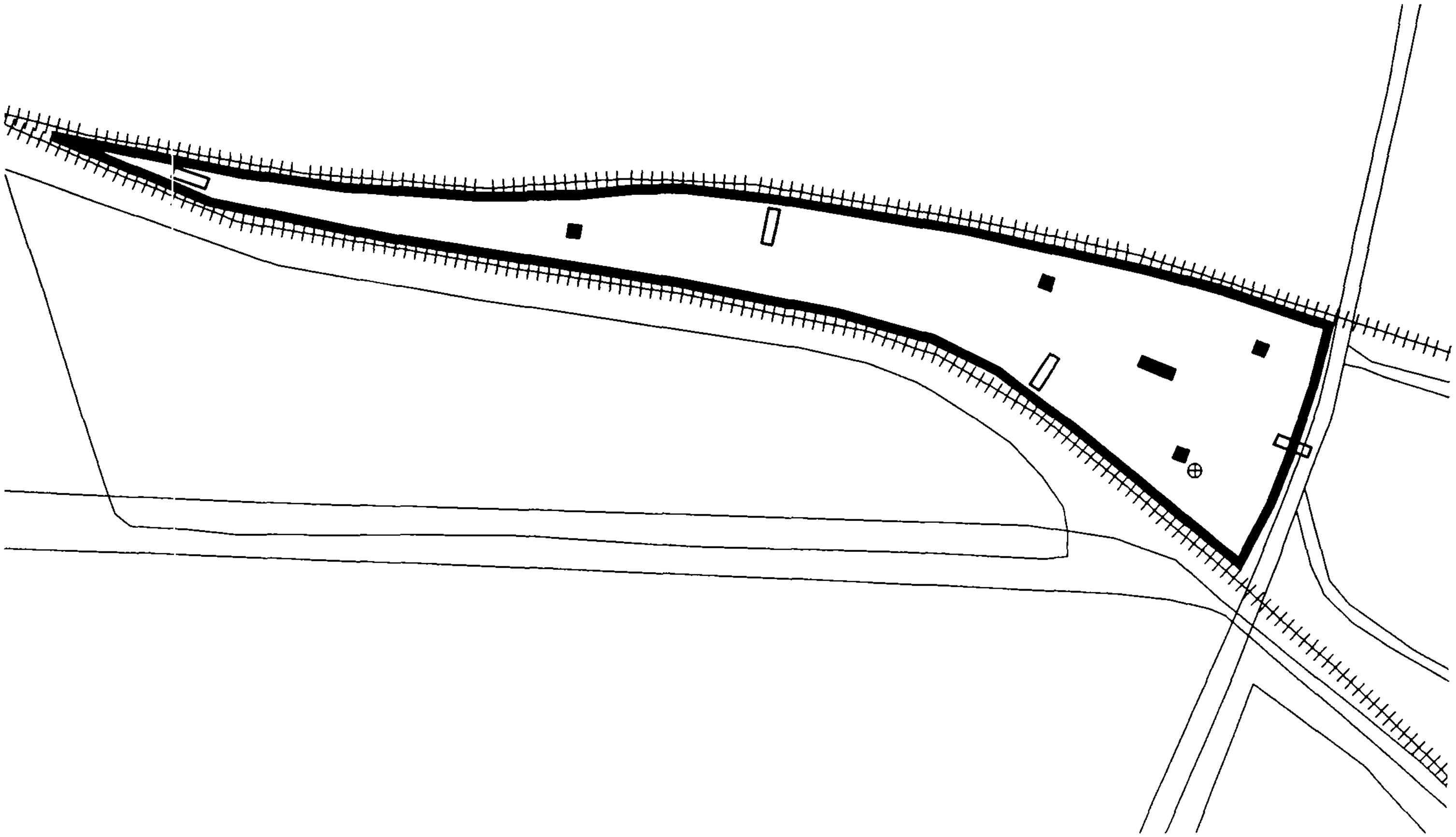
●–●–● Potential Soil Gas Survey Step Out Location

DRN. BY: djd 1/31/01
DSGN. BY: bv
CHKD. BY:

Site O Soil Gas Sampling Locations

FIG. NO. 3

File: E:\2320010024.00\TEST TRENCH.DWG Last edited: 05/24/01 @ 10:09 a.m. WC-ST.LOUIS, MO



LEGEND

⊕ Leachate Monitoring Well

Test Trench (Area Extent of Waste)

Test Trench (Buried Tank/Drum Confirmation)

■ Waste Characterization Boring

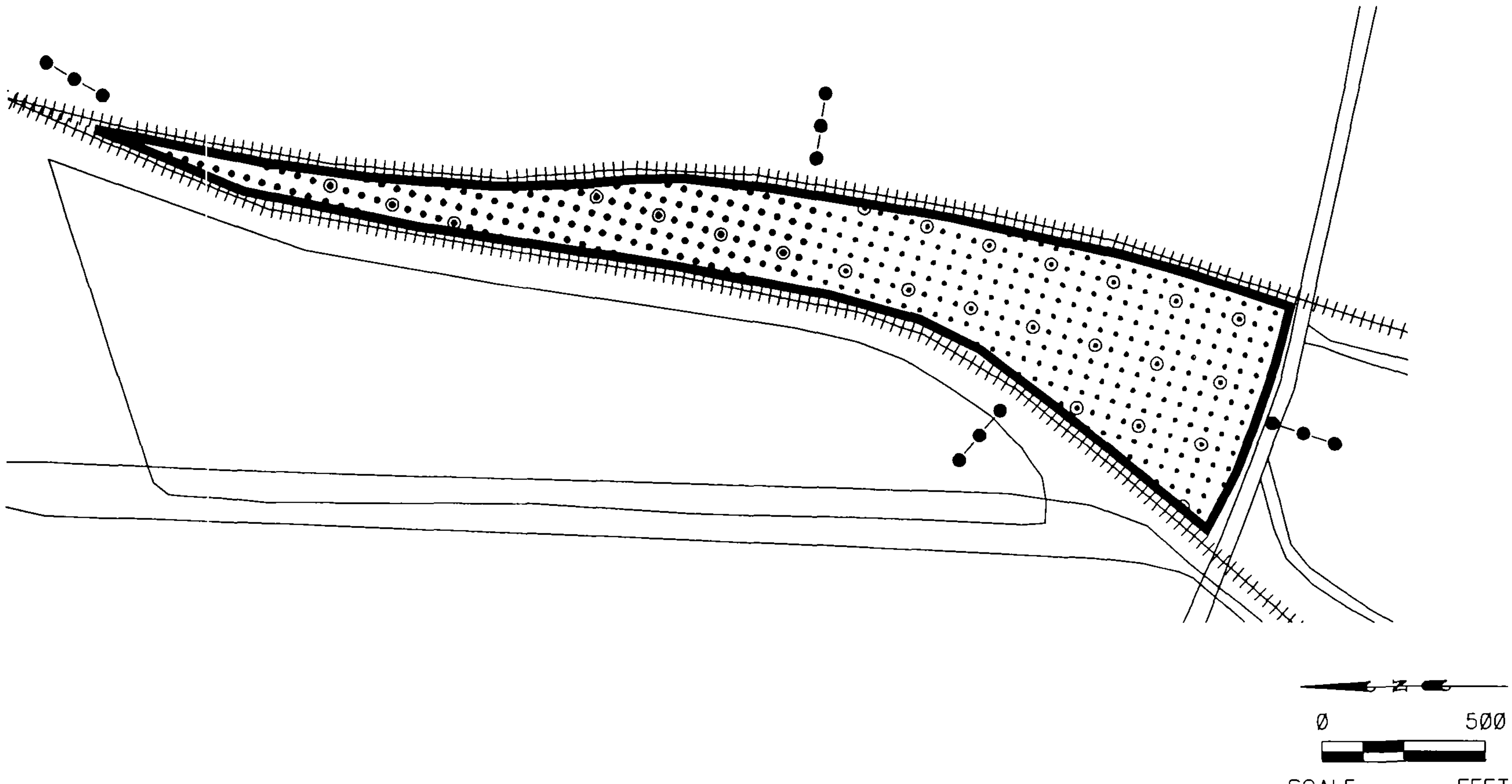
Note: Trench size not to scale; approximate length=20 feet

0 500

SCALE FEET

| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>2320010024.02 | |
|---|---|---|
| URS | | |
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site P Waste, Soil, and Leachate Sampling Locations | FIG. NO.<br>5 |

File: E:\2320010024.00\SOIL GAS.DWG Last edited: 05/24/01 @ 10:14 a.m. WC-ST.LOUIS, MO

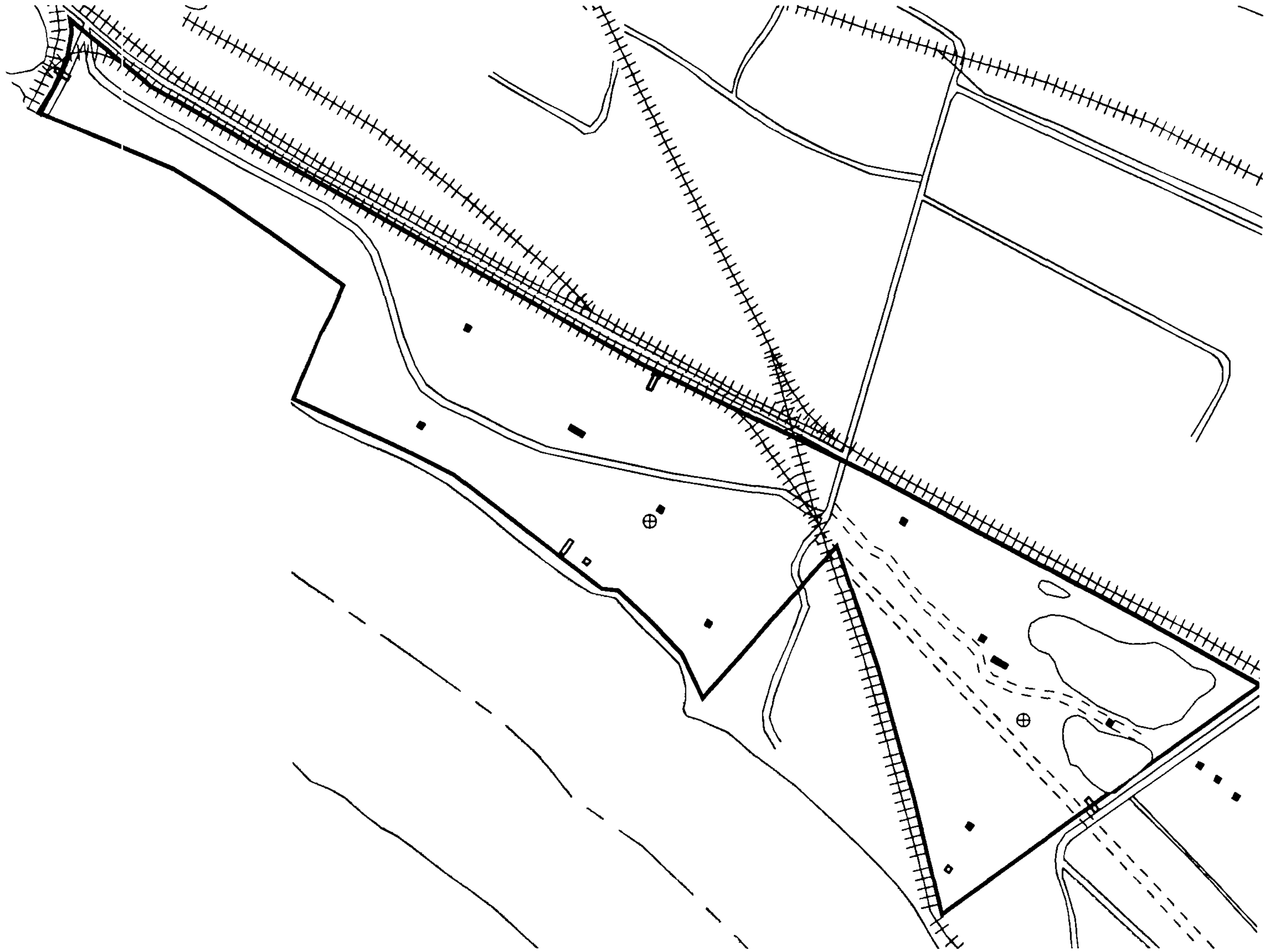



LEGEND

- • Magnetometer Survey Locations
- O Soil Gas Survey Locations
- ●—●—● Potential Soil Gas Survey Step Out Location

| | |
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>2320010024.02 |
| URS | |
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site P Soil Gas Sampling and Magnetometer Measurement Locations |
| FIG. NO.<br>6 | |

File: E:\2320010024.00\TEST TRENCH.DWG Last edited: 05/24/01 @ 10:11 a.m. WC-ST.LOUIS, MO



LEGEND

- ⊕ Leachate Monitoring Well
- Test Trench (Area Extent of Waste)
- Test Trench (Buried Tank/Drum Confirmation)
- Waste Characterization Boring
- Stormwater Sampling Location

Note: Trench size not to scale; approximate length=20 feet

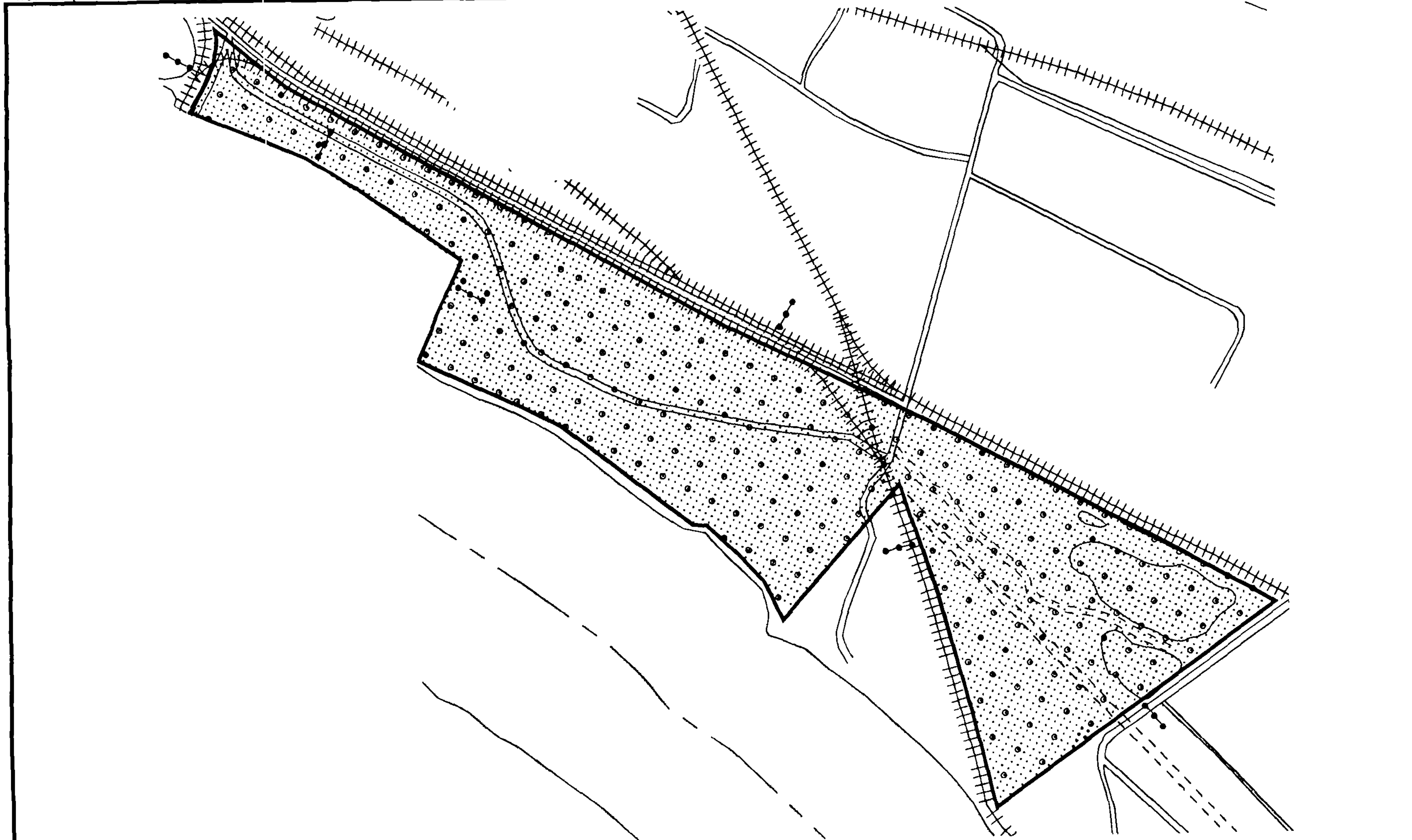
N

0 1000

SCALE FEET

| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | | PROJECT NO.<br>2320010024.02 |
|---|---|---|
| URS | | |
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site Q Waste, Soil, Stormwater, and Leachate Sampling Locations | FIG. NO.<br>7 |

File: E:\2320010024.00\SOIL GAS.DWG Last edited: 05/24/01 @ 10:17 a.m. WC-ST.LOUIS, MO



LEGEND

- • Magnetometer Survey Locations
- ○ Soil Gas, XRF, and GC/MS Survey Locations
- ●—●—● Potential Soil Gas Survey Step Out Location

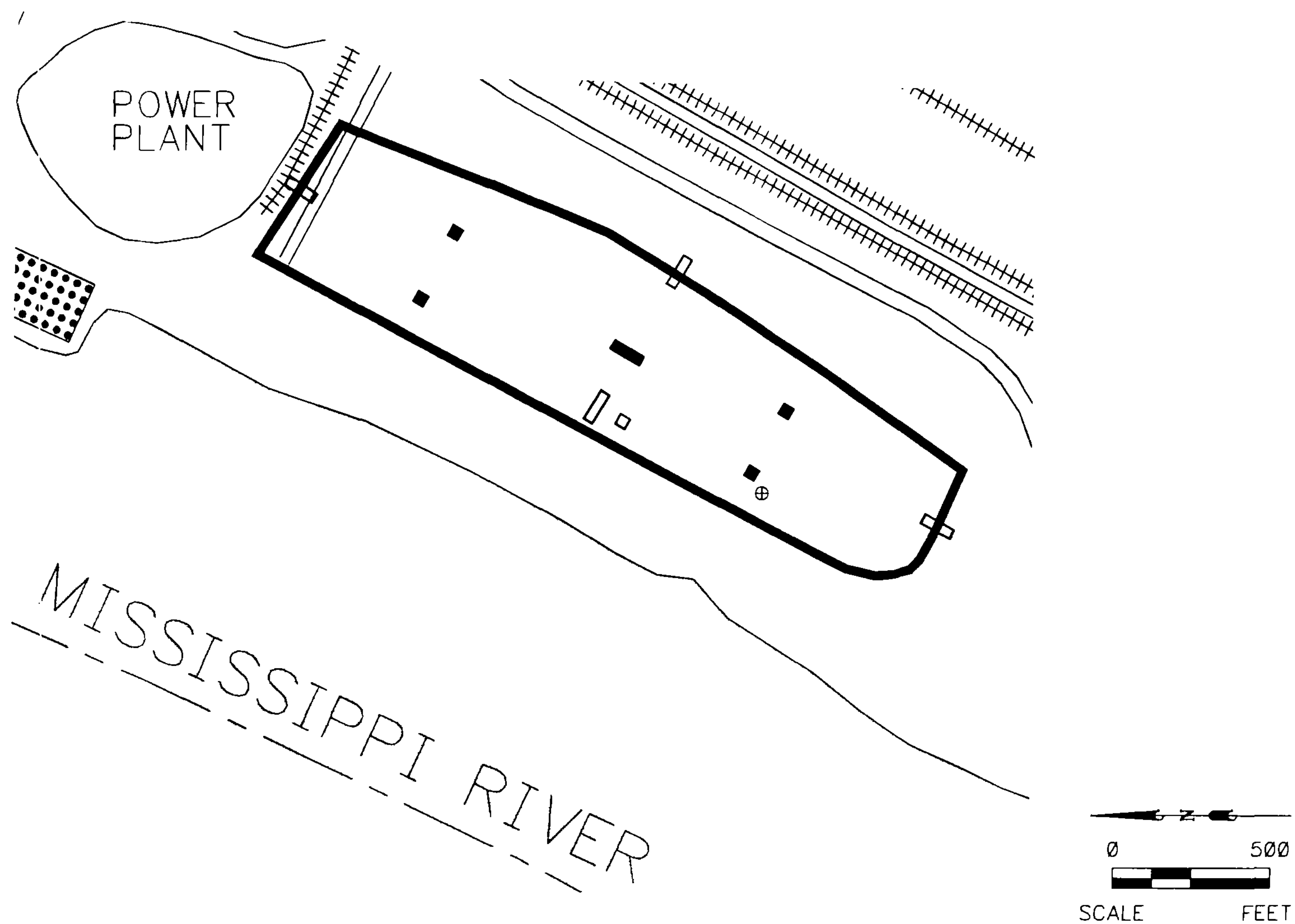
N

0 1000

SCALE FEET

| | |
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>23200010024.02 |
| URS | |
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site Q Soil Gas, XRF, and GC/MS Sampling and Magnetometer Measurement Locations — FIG. NO. 8 |

File: E:\2320010024.00\TEST TRENCH.DWG Last edited: 05/24/01 @ 10:11 a.m. WC-ST.LOUIS, MO




LEGEND

⊕ Leachate Monitoring Well

▭ Test Trench (Area Extent of Waste)

▬ Test Trench (Buried Tank/Drum Confirmation)

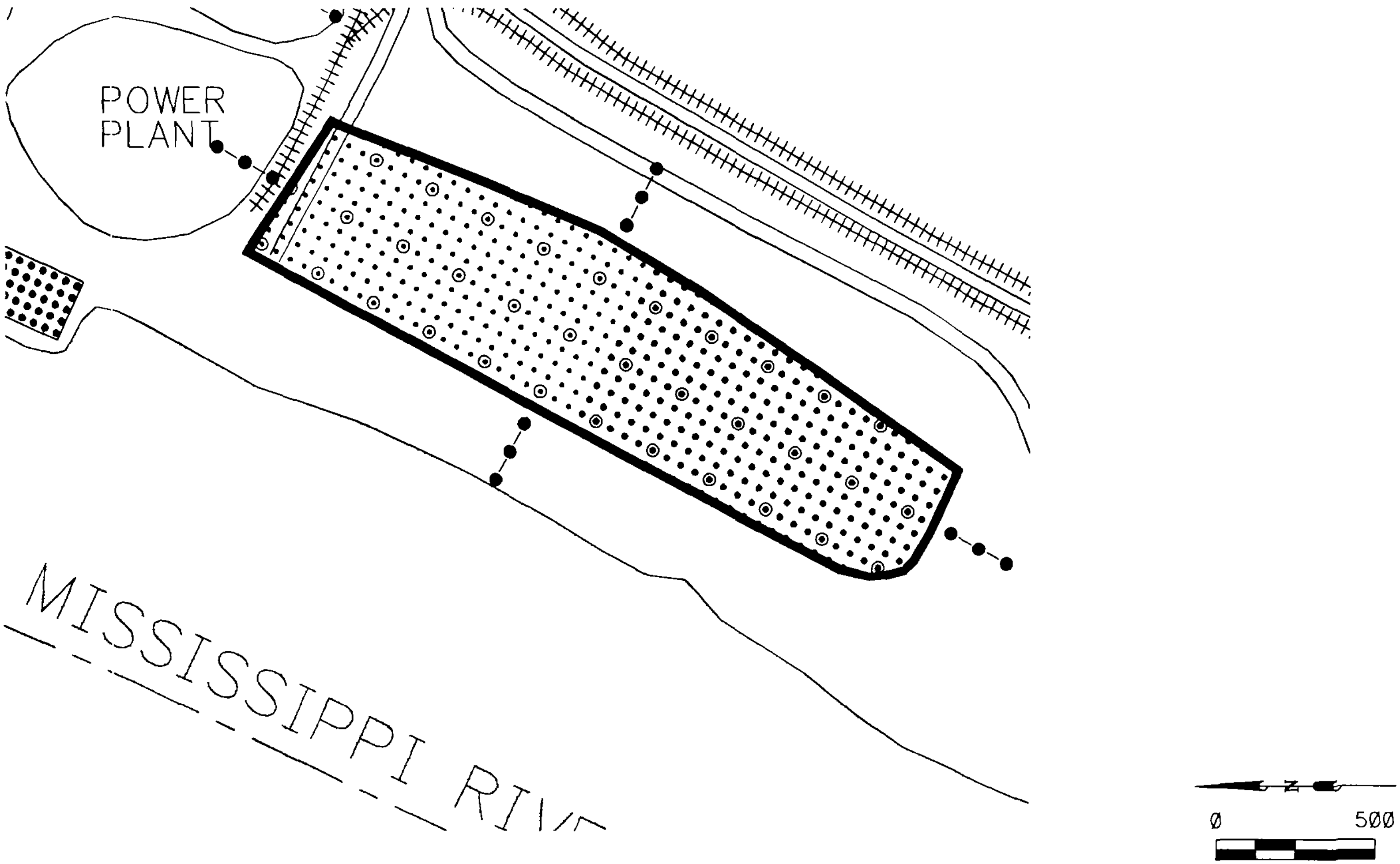
■ Waste Characterization Boring

□ Stormwater Sampling Location

Note: Trench size not to scale; approximate length=20 feet

| | |
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>2320010024.02 |
| URS | |
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site R Waste, Soil, Stormwater, and Leachate Sampling Locations |
| FIG. NO.<br>9 | |

File: E:\2320010024.00\SOIL GAS.DWG Last edited: 05/24/01 @ 10:16 a.m. WC-ST.LOUIS, MO

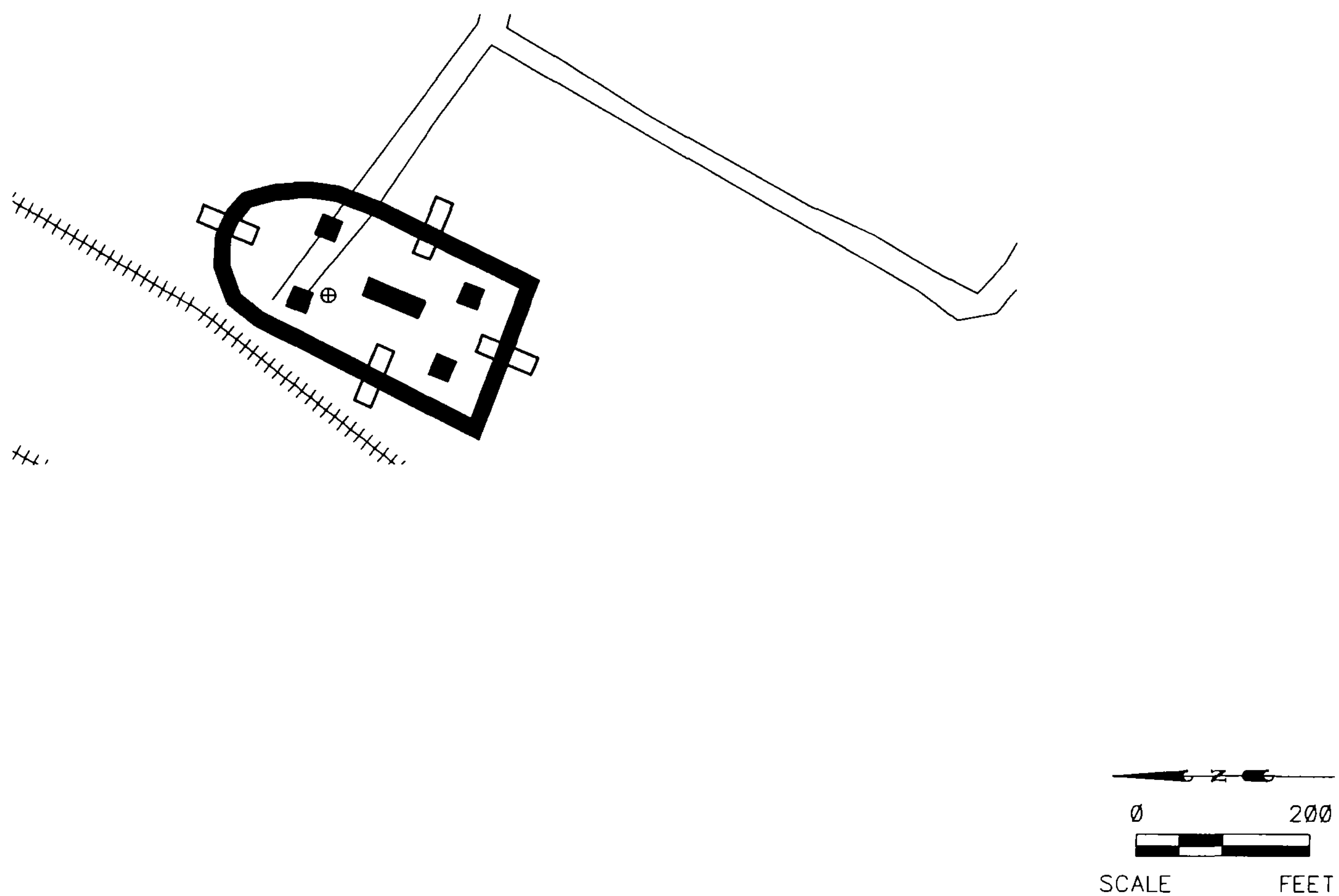



LEGEND

- • Magnetometer Survey Locations
- ○ Soil Gas Survey Locations
- ●–●–● Potential Soil Gas Survey Step Out Location

| | |
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>2320010024.02 |
| URS | |
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site R Soil Gas Sampling and Magnetometer Measurement Locations |
| FIG. NO. | 10 |

File: E:\2320010024.00\TEST TRENCH.DWG Last edited: 05/24/01 @ 10:11 a.m. WC-ST.LOUIS, MO




LEGEND

⊕ Leachate Monitoring Well

▭ Test Trench (Area Extent of Waste)

▬ Test Trench (Buried Tank/Drum Confirmation)

▪ Waste Characterization Boring

Note: Trench size not to scale; approximate length=20 feet

SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN
SAUGET, ILLINOIS

PROJECT NO. 2320010024.02

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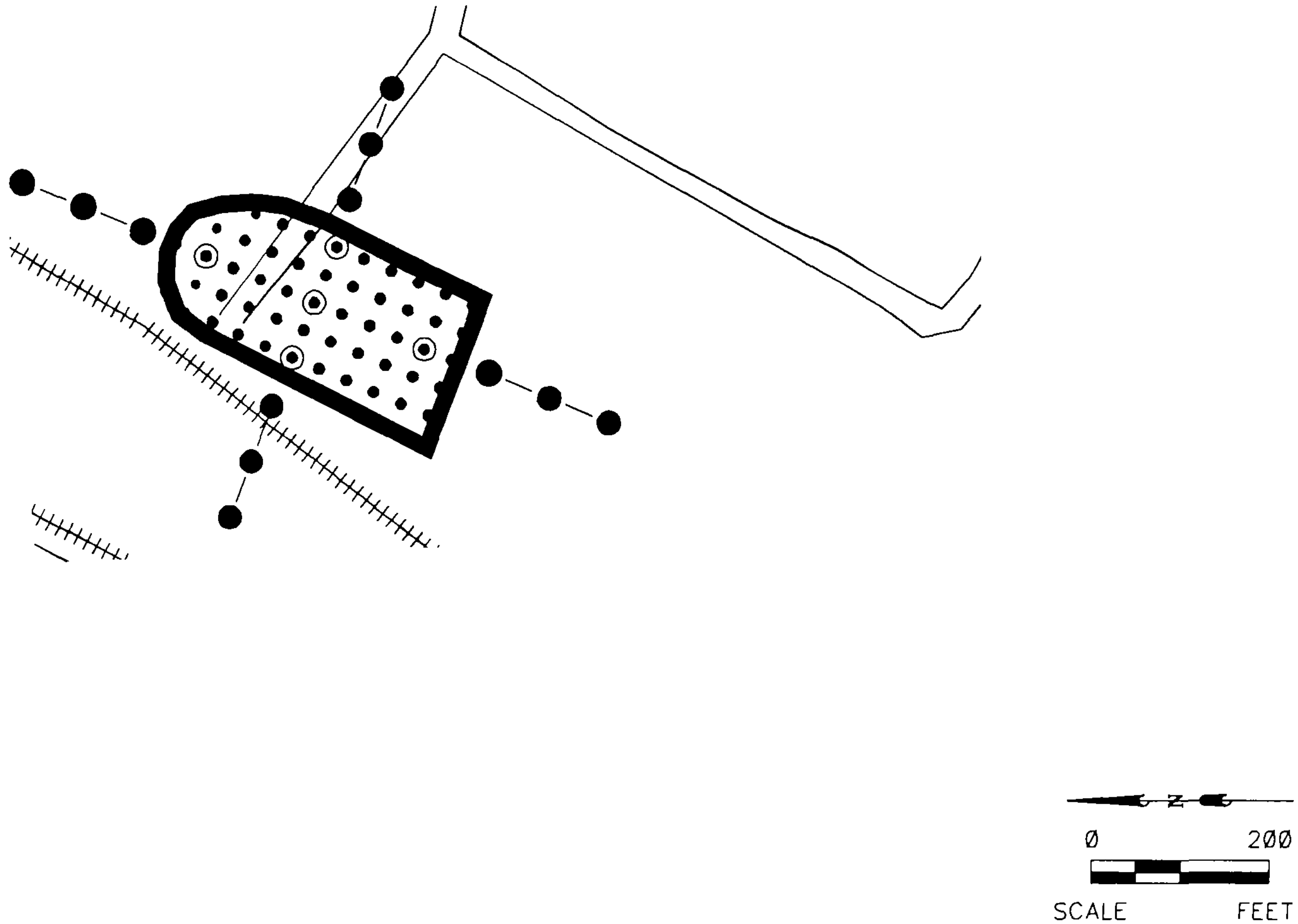
DRN. BY: djd 1/31/01
DSGN. BY: bv
CHKD. BY:

Site S Waste, Soil, and Leachate Sampling Locations

FIG. NO. 11

File: E:\2320010024.00\SOIL GAS.DWG Last edited: 05/24/01 @ 10:15 a.m. WC-ST.LOUIS, MO




LEGEND

- Magnetometer Survey Locations
- ○ Soil Gas Survey Locations
- ●–●–● Potential Soil Gas Survey Step Out Location

| | |
|---|---|
| SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN<br>SAUGET, ILLINOIS | PROJECT NO.<br>2320010024.02 |

URS

| | | |
|---|---|---|
| DRN. BY: djd 1/31/01<br>DSGN. BY: bv<br>CHKD. BY: | Site S Soil Gas Sampling and Magnetometer Measurement Locations | FIG. NO.<br>12 |

# APPENDIX A

# Static Head Space Gas Chromatography, GC/MS, and X-Ray Fluorescence Spectroscopy SOP

# APPENDIX A

## Static Head Space Gas Chromatography, GC/MS, and X-Ray Fluorescence Spectroscopy SOP

Standard Operating Procedures will be developed and provided for these field screening activities upon selection of the contractors who will perform these services.

# APPENDIX B

# Quality Assurance/Quality Control (QA/QC) SOP

# APPENDIX B — Quality Assurance/Quality Control (QA/QC) SOP

QA/QC samples will consist of:

- One duplicate per ten, or fraction of ten, environmental samples collected
- One MS/MSD per twenty, or fraction of twenty, environmental samples collected
- One field blank (or equipment blank) per ten, or fraction of ten, environmental samples collected
- One trip blank for each sample cooler containing samples for VOC analysis.

Duplicate samples are collected to measure consistency of field sampling technique. MS/MSD (matrix spike/matrix spike duplicates) are collected to measure laboratory quality control procedures. The field blank will be submitted to the laboratory with the investigative samples and analyzed for the same parameters as the investigative samples. The minimum required is one per ten, or fraction of ten, environmental samples collected, unless dedicated or disposable sampling equipment is used to collect samples.

# APPENDIX C

# Waste and Soil Sampling SOP

# APPENDIXC

## Waste and Soil Sampling SOP

### *Waste Sample Collection*

The following method will be used to collect waste samples:

1. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples. Sample containers will have a Teflon® septa.
2. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.
3. Place labeled sample containers near the sampling location.
4. Place clean plastic sheeting on the ground surface at the sampling area.
5. Put on a pair of nitrile gloves.
6. The 4-foot long MacroCore® sampler will be driven into the ground. Collect continuous samples from grade to 2 feet below the bottom of waste material. Retrieve the sampler to the surface after each sample collection. Remove the sample from the sampler. For instance, the Geoprobe® will drive the sampler 4 feet into the ground. It will collect a sample from 0 to 4 feet. Retrieve the sampler and empty the soil from it. The Geoprobe® will then drive the sampler 4 feet further into the ground and collect soil from a 4- to 8-foot depth. Retrieve the sampler to the surface and empty it again. Continue this process until continuous samples have been collected from ground surface to 2 feet below the bottom of the waste material.
7. VOC samples cannot be composited without losing volatiles. Thus, use the waste sample with the highest PID readings for VOC analysis. Collect the VOC sample with a 5-gram EnCore® sampler. After pressing the sampler into the soil at the desired location within the split spoon, cap the coring body while it is still in the EnCore® sampler T-handle. Place the remainder of the split spoon sample into a stainless steel bowl and homogenize it. Fill the remaining sample containers from the steel bowl.
8. Use the sample with the highest PID reading for dioxin analysis.
9. Place the sample containers on ice in a cooler.

10 Begin chain-of-custody procedures. A sample chain-of-custody form is included as Appendix F.

11 Decontaminate the sample equipment as described below.

***Surface Soil Sample Collection***

Use the following procedure to collect a sample:

1. If necessary, penetrate the soil to the appropriate sampling depth.
2. Using a clean tool, remove and discard a thin layer of soil from the area. Record the characteristics of the soils, including grain size, content, staining, and color.
3. To collect a discrete soil sample for VOC analysis, a 5-gram EnCore® sampler will be used. After pressing the sampler into the soil at the sampling location, cap the coring body while it is still in the EnCore® sampler T-handle. To collect a discrete soil sample for other parameters, use a stainless steel laboratory spoon or equivalent. Homogenize the non-VOC samples as necessary.
4. Place the homogenized sample into appropriate sample containers. In addition to analytical samples, a reference sample considered representative of the soil may also be collected in a wide mouth jar and stored for possible future physical analyses such as grain size analysis.
5. Check that the cap of each sample container has a Teflon® liner, if required for the analytical method. Secure the cap tightly.
6. Label the sample container with the appropriate sample tag. The tags could be permanent labels or clean tape. Label the tag carefully and clearly using indelible ink. Complete appropriate sampling forms and record in the field notebook. Pre-labeled containers are handy, particularly if you are wearing gloves or if the weather is inclement.
7. Initiate the chain-of-custody form.
8. Place the capped EnCore® sampler core bodies and other sample containers on ice in a cooler to maintain the samples at approximately 4°C. Ship the cooler to the laboratory for analysis within 48 hours of sample collection.
9. Decontaminate equipment between sample locations and after use as described below.

### *Subsurface Soil Sample Collection*

The sampling procedure will be as follows.

1. Borings will be advanced via direct push technology (Geoprobe®). The Geoprobe® will hydraulically drive a stainless steel, acetate-lined MacroCore® sampler (2-inch diameter by 4-foot length) to the desired subsurface sample depth. Following sample collection, the sampler will be retrieved to the surface and the soil sample removed from the disposable acetate liner within the sampler.
2. One subsurface soil sample will be collected from 0.5 to 6 feet within each boring. The soil from 0.5 to 6 feet will be screened, in the field, for evidence of impact with visual and olfactory observation and a photoionization detector (PID). The soil interval exhibiting the greatest impact will be submitted to the laboratory for analysis.
3. A 5-gram EnCore® sampler will be used to collect VOC samples from the subsurface soil. Use the EnCore® sampler to collect a VOC sample from the top portion of sample in the MacroCore® sampler.
4. Of the four subsurface soil samples collected within the site, visual and olfactory observation and PID readings will also be used to identify the most impacted sample. This sample will be used for dioxin analysis.
5. Descriptive logs of each boring will be prepared as described in Appendix D.
6. Follow chain-of-custody procedures.
7. All borings will be grouted to the surface, following retrieval of both the waste and soil samples.

Boring equipment will be decontaminated and investigation-derived waste will be disposed of as described below.

# APPENDIXD

## Test Boring Logs

URS

# LOG OF BORING ____________

SHEET 1 of 1

| PROJECT NAME/NUMBER | Sauget Area 2 Site/23-20010024.02 | DATE STARTED | DATE COMPLETED |
|---|---|---|---|
| LOCATION | Sauget Illinois | | |
| DRILLING CONTRACTOR | FOREMAN | GROUND ELEVATION (FT. MSL) | WATER DEPTH (FT BGS): |
| DRILLING EQUIPMENT | | COMPLETION DEPTH (FT BGS) | ROCK DEPTH (FT BGS) |
| GEOLOGIST/ENGINEER | | BORING LOCATION | |

| DESCRIPTION | Sample Run | Depth (FT BGS) | Water Table | SAMPLES Recov. (in) | SAMPLES Penetra. Tons/ $ft^2$ | USC | PID Readings Head Space (ppm) | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

# APPENDIX E

## Guidance for Soil Sample Logs

# APPENDIXE Guidance for Soil Sample Logs

At the outset of sample logging, the on-site geologist will record field notes with waterproof ink in a bound field notebook. At a minimum, the daily field notes will include:

- Project name and number
- Date and time
- Weather conditions
- Sampler's name
- Project objective(s).

Throughout the sampling round, the following items will be recorded as appropriate:

- Sample location(s)
- Sample identifications
- Limiting field conditions
- Problems encountered.

A copy of the boring log to be used is included as Appendix D.

Unconsolidated soil samples will be described as follows:

- Descriptive information:
  - Color name (Munsell Color Chart) of the logged interval or sample
  - Color notation including chroma, hue, value, and qualifiers

1. Mottling with abbreviations, descriptors, and criteria for descriptions of mottles as identified below

**Descriptors for Mottling**

| Abundance | Size | Contract |
|---|---|---|
| f: few (<2%) | fine (<5 mm) | faint |
| c: common (2%-20%) | medium (5-15 mm) | distinct |
| m: many (>20%) | coarse (>15 mm) | prominent |

2. Degree of saturation (dry, damp, moist, wet, saturated, or combinations); note depth to groundwater table, if observed

3 Degree of density. Count the blows of each 12-inch increment of the sampler (ASTM-1586-84). Use the values and the density table presented below to determine the degree of density.

**Degree of Density**

| Cohesive Clays | | Non-cohesive Granular Soils | |
|---|---|---|---|
| 0-2 | very soft | 0-3 | very loose |
| 2-4 | soft | 4-9 | loose |
| 5-7 | firm | 10-29 | medium dense |
| 8-15 | stiff | 30-49 | dense |
| 16-29 | hard | 50-80 | very dense |
| 30-49 | very hard | 80+ | extremely dense |
| 50-80 | extremely hard | | |

4 Soil description according to ASTM's Unified Soil Classification System (USC) and by soil structure:

- ASTM Unified Soil Classification: The Grade Limits and Grade Standards table presented below provides the grade limits and grade names used by engineers according to ASTM standards D422-63 and D643-78.

**Grade Limits and Grade Standards**

| Grade Limits mm | Grade Limits inch | Grade Names US standard sieve series | Grade Names |
|---|---|---|---|
| | | | boulders |
| 305 | 12.0 | | |
| | | | cobbles |
| 76.2 | 3.0 | 3.0 inch | |
| | | | gravel |
| 4.75 | 0.19 | No. 4 | |
| 2.00 | 0.08 | No. 10 | |
| | | | medium sand |
| 0.425 | | No. 40 | |
| 0.074 | | No. 200 | |
| | | | silt |
| 0.005 | | | |
| | | | clay size |

Source: AGI data sheet 29.2

- Course-grained soils include clean gravels and sands and silty or clayey gravels and sands with more than 50% retained on the No. 200 sieve. A table of USC symbols and names for coarse-grained soils is presented below.

### USCS Symbols and Names for Coarse-grained Soils

| USCS Symbol | Typical Names |
|---|---|
| GW | Well graded gravels, gravel-sand mixtures, little or no fines |
| GP | Poorly graded gravels, gravel-sand mixtures, little or no fines |
| GM | Silty gravels, gravel-sand-silt mixtures |
| GC | Clayey gravels, gravel-sand-clay mixtures |
| SW | Well graded sands, gravelly sands, little or no fines |
| SP | Poorly graded sands, gravelly sands, little or no fines |
| SM | Silty sand, sand-silt mixtures |
| SC | Clayey sands, sand-clay mixtures |

– Fine-grained soils include inorganic and organic silts and clays; gravelly, sandy, or silty clays; and clayey silts with more than 50% passing the No. 200 sieve. A table of USC symbols and names for fine-grained soils is presented here.

### USCS Symbols and Names for Fine-grained Soils

| USCS Symbol | Typical Names |
|---|---|
| ML | Inorganic silts and very fine sands, rock flour, silty, or clayey fine sands, or clayey silts with slight plasticity |
| CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| OL | Organic silts and organic silty clays of low plasticity |
| MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts |
| CH | Inorganic clays or high plasticity (residual clays), fat clays |
| OH | Organic clays of medium to high plasticity, organic silts |
| Pt | Peat and other highly organic soils |

A table of soil descriptors is presented below. (this goes with #4, needs hyphened bullet)

### Soil Descriptors

| | |
|---|---|
| Calcareous: | containing appreciable quantities of calcium carbonate |
| Fissured: | containing shrinkage cracks, often filled with fine sand or silt, usually more less vertical |
| Interbedded: | containing alternating layers of different soil types |

### Soil Descriptors

| | |
|---|---|
| Intermixed: | containing appreciable, random, and disoriented quantities of varying color, texture, or constituency |
| Laminated: | containing thin layers of varying color, texture, or constituency |
| Layer: | thickness greater than 3 inches |
| Mottled: | containing appreciable random speckles or pockets of varying color, texture, or constituency |
| Parting: | paper thin |
| Poorly graded (well sorted): | primarily one grain size, or having a range of sizes with some intermediate size missing |
| Slickensided: | having inclined planes of weakness that are slick and glossy in appearance and often result in lower unconfined compression cohesion |
| Split graded: | containing two predominant grain sizes with intermediate sizes missing |
| Varved: | sanded or layered with silt or very fine sand (cyclic sedimentary couplet) |
| Well graded (poorly sorted): | containing wide range of grain sizes and substantial amounts of all intermediate particle sizes |
| Modifiers: | Predominant type - 50% to 100%<br>Modifying type - 12% to 50%<br>With - 5% to 12%<br>Trace - 1% to 5% |

5 Degree of plasticity. The following table presents the terms used to denote the various degrees of plasticity of soil that passes the No. 200 sieve.

### Degrees of Plasticity

| Descriptive Term | Degree of Plasticity | Plasticity Index Range |
|---|---|---|
| SILT | none | non-plastic |
| Clayey SILT | slight | 1-5 |
| SILT & CLAY | low | 5-10 |
| CLAY & SILT | medium | 10-20 |
| Silty CLAY | high | 20-40 |
| CLAY | very high | over 40 |

6 Drilling information:

- Drill rig manufacturer, model, and driller (if applicable)
- Geologist or geotechnical engineer
- Project name, sample point identification, and location

- Date samples obtained (and times if required)
- Type of sampler (e.g., split spoon, Shelby, California), measurements or method of advancing boring or equipment, method of driving sampler, and weight of hammer
- Drill fluids (if applicable)
- Ground surface or grade elevation (if known)
- Depth penetrated and blow counts/6-inch interval of penetration for ASTM 1586-84 and sample number (if applicable)
- Closed hole intervals and advancement (if applicable)
- Recovery
- Strata changes and changes within samples
- Sampling tool behavior
- Drill string behavior
- Use(s) of borehole
- Disposition(s) of residual soil or cuttings
- Signature or sampling of log (as required)

# APPENDIX F

## Sample Chain-of-Custody

CHAIN OF CUSTODY RECORD



| Project Name | | Project No. | | Analytical Parameters |
|---|---|---|---|---|
| Project Location | | Project Manager | | |
| Sampler(s) | | | | |

| Sample Date | Sample Time | Type Comp. | Type Grab | Sample Identification | Matrix | Containers No. | Containers Type | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | |
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| Signatures | Date | Time | Shipping Details | Special Instructions |
|---|---|---|---|---|
| Relinquished by: | | | Method of Shipment | |
| Received by: | | | Airbill No. | |
| Relinquished by: | | | Lab Address | |
| Received for Laboratory by: | | | | |

Custody.frm/jdg 3-09-92

White copy - Laboratory Yellow copy - Laboratory Pink copy - WCC

# APPENDIX G Typical Well Construction Diagrams and Well Installation SOP

# APPENDIX G Typical Well Construction Diagrams and Well Installation SOP

**Well Construction SOP**

- Well materials will be inspected for proper specifications and integrity.
- The well screen, bottom cap, plug, and riser will be certified clean from the manufacturer. If they are not, they will be cleaned with a high-pressure steam cleaner.
- The total depth of the borehole will be measured, referenced to existing grade, and recorded. The quantities and lengths of all materials placed in the borehole will be measured and recorded. These materials include, but are not limited to: screen interval, blank casing or riser length, filter pack, bentonite seal, grout, and protective casing.
- The well must be straight and vertical. Centralizers will be used as necessary to keep the monitoring well centered in the borehole.
- The filter pack will consist of an appropriately graded, washed silica sand. The volume of filter pack necessary to fill the annular space will be computed and used to monitor the progress of installing the filter pack. The filter pack will be emplaced in increments to prevent bridging. If bridging occurs, the bridge will be broken before proceeding. The depth of the filter pack will be continuously checked with a weighted tape. The filter pack will extend a minimum of 2 feet above the top of the well screen.
- The augers or temporary casing will be withdrawn in no more than 5-foot increments to limit borehole collapse during emplacement of the filter pack. The lowest point of the casing or auger will not be more than 2 feet higher than the top of the filter material.
- A bentonite slurry seal will be tremied in place above the filter pack. The bentonite slurry seal will extend a minimum of 2 feet and not more than 3 feet above the top of the filter pack.
- A cement and bentonite grout mixture will be tremied in place above the top of the bentonite slurry seal to 3 feet below existing grade. The grout mixture will be installed from the top of the bentonite seal upward to reduce the opportunity for the development of void spaces in the emplaced grout. The grout mixture must be pH neutral so as not to modify the pH of the groundwater.
- A protective casing will be installed which extends from below the frost line to slightly above the top of the well casing. A weep hole will be drilled into the protective casing so accumulated water can drain.

- The concrete to be used to complete surface installation will be a commercially available, premixed cement, sand, and gravel mixture (e.g., Quickrete).

# MONITORING WELL CONSTRUCTION DIAGRAM

GROUND SURFACE ELEVATION ____________

TOP OF INNER WELL CASING ELEVATION ____________

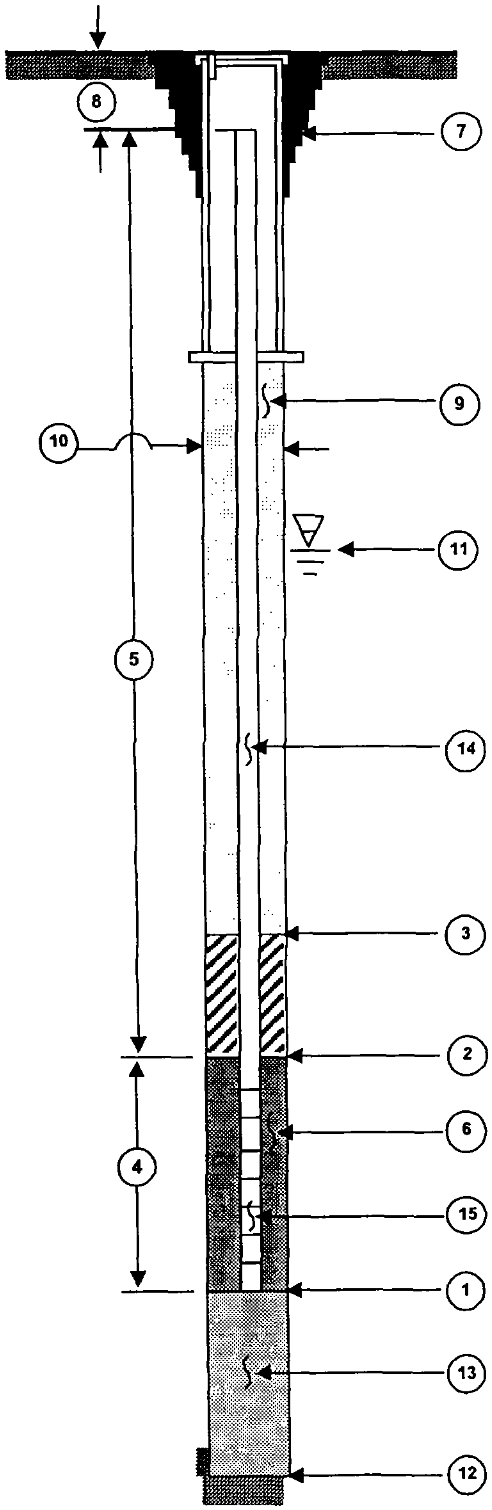
DATUM ____________

JOB NUMBER ____________

BORING NUMBER ____________

INSTALLATION DATE ____________

LOCATION ____________




1. DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE ____________ FEET.*
2. DEPTH TO BOTTOM OF SEAL (IF INSTALLED) ____________ FEET.*
3. DEPTH TO TOP OF SEAL (IF INSTALLED) ____________ FEET.*
4. LENGTH OF WELL SCREEN ________ FEET. SLOT SIZE ____________
5. TOTAL LENGTH OF RISER PIPE ________ FEET AT ____________ INCH DIAMETER.
6. TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE ____________
7. CONCRETE CAP? YES NO (CIRCLE ONE)
8. DEPTH TO TOP OF INNER CASING BELOW GROUND SURFACE ____________ FEET.
9. TYPE OF UPPER BACKFILL ____________
10. BOREHOLD DIAMETER ____________ INCHES.
11. DEPTH TO GROUNDWATER ________ FEET BELOW TOP OF INNER CASING ________ HOURS AFTER WELL DEVELOPMENT.
12. TOTAL DEPTH OF BOREHOLE ________ FEET.*
13. TYPE OF LOWER BACKFILL ____________
14. PIPE MATERIAL ____________
15. SCREEN MATERIAL ____________

* (DEPTH FROM GROUND SURFACE)

## MONITOR WELL INSTALLATION DETAILS

URS Corporation

P:/BOILER/EXCEL/MONITORWELLFLUSH

# MONITORING WELL CONSTRUCTION DIAGRAM

GROUND SURFACE ELEVATION ______________

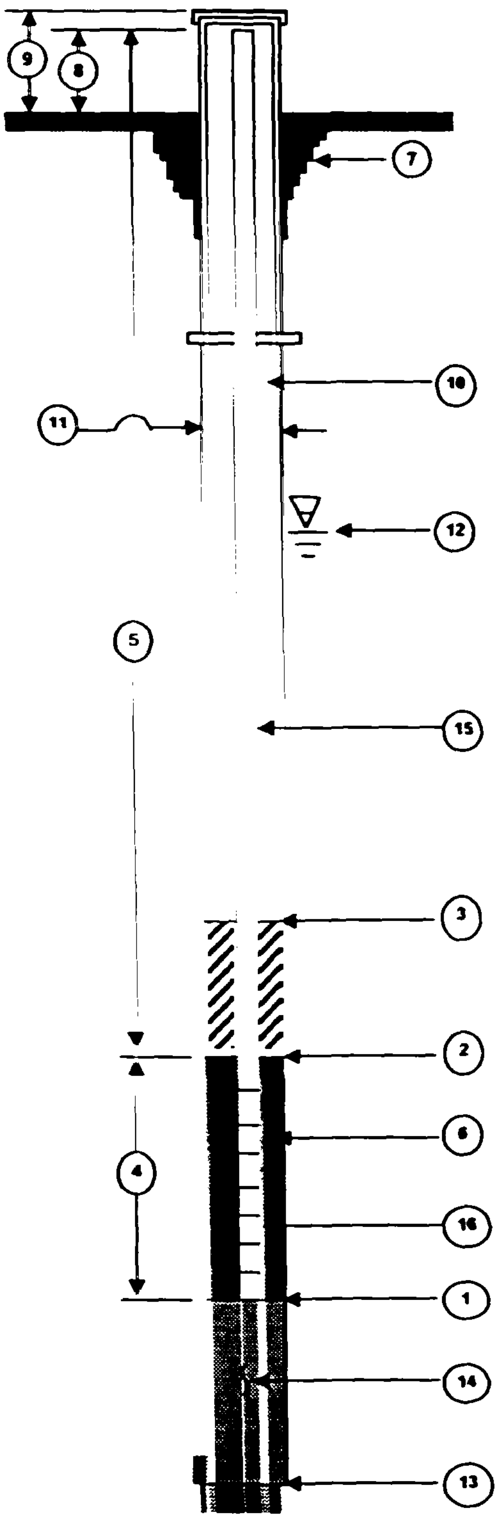
TOP OF INNER WELL CASING ELEVATION ______

JOB NUMBER ______________

BORING NUMBER ______________

INSTALLATION DATE ______________

LOCATION ______________




1 DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE ______ FEET *

2 DEPTH TO BOTTOM OF SEAL (IF INSTALLED) ______ FEET *

3 DEPTH TO TOP OF SEAL (IF INSTALLED) ______ FEET *

4 LENGTH OF WELL SCREEN ______ FEET
SLOT SIZE ______ INCHES

5 TOTAL LENGTH OF RISER PIPE ______ FEET AT ______ INCH DIAMETER

6 TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE ______

7 CONCRETE CAP? YES NO (CIRCLE ONE)

8 HEIGHT OF WELL CASING ABOVE GROUND ______ FEET

9 PROTECTIVE CASING YES NO (CIRCLE ONE)
HEIGHT ABOVE GROUND ______ FEET
LOCKING CAP? YES NO (CIRCLE ONE)

10 TYPE OF UPPER BACKFILL ______

11 BOREHOLE DIAMETER ______ FEET BELOW TOP.

12 DEPTH TO GROUND WATER ______ FEET

13 TOTAL DEPTH OF BOREHOLE ______ FEET *

14 TYPE OF LOWER BACKFILL ______

15 PIPE MATERIAL ______

16 SCREEN MATERIAL ______

* (DEPTH FROM GROUND SURFACE)

URS Corporation

# APPENDIX H

# Well Development and Well Purging SOPs

# APPENDIXH Well Development and Well Purging SOPs

## *Well Development*

The objective of groundwater monitoring well development is to clear the well of accumulated sediments, when 10% or more of the well screen has been occluded by sediment, so that representative groundwater samples may be collected. The accumulated sediments need to be re-suspended in the water column in order to be removed. A variety of techniques can be used to re-suspend the sediments. Some of the common methods that can be used to re-suspend sediments include using a surge block, injection of air into the water column of the well, or using a bailer. Once the sediment is re-suspended, the water and sediment can then be removed from the well using a submersible pump, an air bladder pump, or a bailer. Development will be considered to be complete when the fine-grained materials have been removed.

The preferred method for development will be surging and removing water with dedicated, disposable, polyethylene bailers or a submersible pump. The following procedures will be used when developing an existing well.

1. Place a clean, plastic drop cloth on the ground around the well to be developed.
2. Unlock the protective well cover and remove the well cap.
3. Check the well for NAPL using an interface probe, as outlined in the water level measurement section below.
4. Measure the depth to groundwater and/or NAPL to the nearest hundredth of a foot.
5. Measure the total depth of the well to the nearest hundredth of a foot. Note whether the bottom of the well feels hard or soft.
6. Attach the decontaminated surge block to the appropriate lengths of pole section and push the surge block to the bottom of the well, or send a bailer to the bottom of the well.
7. Pull and push the surge block/bailer up and down to agitate the water and suspend the sediments in the well.
8. Once sufficient re-suspension has occurred, pull the surge block/bailer out of the well.
9. Attach an appropriate length of polyethylene tubing to a submersible pump, and lower the pump to near the bottom of the well, out of sediment that may be remaining in the bottom of the well.

10. Place the discharge end of the tubing such that purged water will be collected in a 55-gallon drum.

11. Turn on the pump and adjust the flow rate to pump at a sufficiently high rate to allow the sediments to be removed without causing the pump to clog.

12. Continue pumping until relatively sediment-free water is obtained.

13. Remove the pump and allow the well to recover for half an hour. Re-measure the total well depth. If the measured depth indicates 10% or more occlusion, repeat steps 8 through 14. If the measured depth indicates less than 10% well screen occlusion, disconnect the tubing from the pump and place into the appropriate waste container. Dismantle the surge block and pole connectors for decontamination. Pick up and appropriately dispose of plastic sheeting and other disposables into the appropriate waste container. Close and properly label the 55-gallon drum(s).

14. Decontaminate the pump, wiring, and any other equipment, using the steam cleaner.

Note in the field log book the approximate number of gallons of water removed during development of each well.

### *Well Purging*

Prior to initiating the well purging process, the following information will be recorded in a field notebook and on the groundwater sampling logs (Appendix N).

- Well number
- Day, date, and time
- Weather conditions
- Condition of the well and surrounding area
- Sampling team members
- Instrument calibration information
- Water level prior to purging
- Depth to the bottom of the well
- Volume of water to be purged

- Physical properties of evacuated water: color, odor, turbidity, presence of non-aqueous phase liquids
- Deviations from planned sampling methodology
- Ambient air monitoring readings

Low-flow purging techniques will be used to purge the well in accordance with RCRA Groundwater Monitoring TEGD guidelines. These guidelines state that purging will be conducted by removing a minimum of three well volumes of fluid. A well volume of water is calculated using the following formula: $V = \pi r^2 h(7.48)$ where

$V$ = Standing water volume in gallons to be purged

$r^2$ = Inside radius of well in feet, squared

$h$ = Linear feet of standing water in the casing

One well volume will be calculated so field personnel know when to perform field measurements. Such measurements are performed after the removal of each well volume.

In groundwater systems, naturally occurring metals tend to adsorb to the surfaces of solids. The level of adsorbance depends on the pH of the soil and water. The concentration of metals in dissolved form, therefore, is limited by this adsorption and by the metals' low solubilities. Sediment in water is likely to have metal ions adsorbed to its particles, which analytical methods may not be able to differentiate from metal ions dissolved in the water. Groundwater samples that contain sediment, therefore, may yield analytical results that do not represent the concentration of metals in the groundwater itself.

Moreover, the transport of sediment is generally not due to the natural flow of groundwater, but is induced by the sampling. Samples that are collected for metals analysis should exhibit low turbidity, and they are generally filtered to remove sediment. When possible, low turbidity samples should be obtained without filtering. A turbidity meter will be used to monitor turbidity during sampling. Following the extraction of each well volume, turbidity will be monitored in the field. Additionally, pH, conductivity, and temperature will be measured and recorded after each well volume removed. Purging is deemed complete when these parameters have stabilized within 10% over a minimum of two successive well volumes. Samples will be collected when turbidity levels are below 5 nephelometric turbidity units (NTU). Should a turbidity level of 5

NTU be unachievable after 2 hours of purging, the samples will be collected and the turbidity recorded

The procedures for well purging are described as follows:

- The low-flow pump will be lowered into the well, and the pump intake will be located at the approximate midpoint of the screened interval. Once the pump is in place, the controller will be set for the desired flow rate. The optimum flow rate is dependent on the site-specific hydrogeology and will be determined in the field, however, the flow rate will not exceed 1 L/min.
- Pump the groundwater into a graduated pail. Continue pumping until the turbidity reading is at or below 5 NTU unless that is unattainable then the turbidity reading is within 10% for two consecutive well volumes, the well is pumped dry.
- If the well is purged dry, allow sufficient time for the well to recover before proceeding. Record this information on the groundwater sampling log.
- In addition to the turbidity readings, in wells which exhibit sufficient recharge, also collect pH, conductivity, and temperature measurements. A minimum of two consecutive measurements should be within the following criteria:
  - ±0.25 units for pH
  - ± 10% for specific conductivity
  - ± 1 C° for temperature

  Record this information on the groundwater sampling log.

Discharge the water removed during purging or possible decontamination procedures into 55-gallon drums for disposal.

# APPENDIX I
## Well Gauging and Groundwater Sampling SOPs

# APPENDIX I — Well Gauging and Groundwater Sampling SOPs

### *Water Level Measurements (Well Gauging)*

Groundwater level measurements will be collected as follows:

- A pre-cleaned, electric water level or NAPL interface probe will be used to measure the depth to water from the top-of-casing reference point and/or check for NAPLs in the water column, where applicable. Record the depth of water and/or NAPLs, as applicable. This procedure will also be used to measure the depth of the well. Measurements will be made to the nearest 0.01 feet.
- After obtaining the water level, the volume of water within the well will be calculated.

Decontaminate the water level and NAPL interface probe used in the well by thoroughly scrubbing with Alconox® and a potable water wash. Rinse with potable water, and then rinse twice with distilled water.

### *Pre-sampling Procedures*

As part of a sampling event, the following steps will initially be taken by personnel responsible for sampling:

- Obtain appropriate containers for sample collection. Containers will be provided by the laboratory performing the analyses.
- Examine sampler, containers, and preservatives; contact laboratory immediately if problems are found.
- Confirm sample delivery time and method of sample shipment with the laboratory.
- Assemble and inspect field equipment to be used for sample collection; verify that equipment is clean and in proper working order.
- Calibrate field instruments and/or meters to manufacturers' specifications. Conductivity, pH, and turbidity meters will be calibrated to known calibration standard solutions. Re-check calibration prior to the start of each day and after four hours of use. Calibration activities will be recorded on the groundwater sampling log (Appendix N) and in the field notebook.
- Perform NAPL interface probe function test in accordance with QAPP guidelines.

- Establish well location and well identification.
- Obtain necessary keys for wells or gates.
- As feasible, begin sampling procedures at monitoring wells that are least impacted and proceed to those that historically have been impacted. A review of previous analytical data will be required prior to sampling.
- Examine each well for damage, tampering, erosion around the well casing, etc., and note on respective field log sheet.
- Place clean plastic sheeting around well to provide a barrier between the surrounding ground surface and sampling equipment used
- Put on a new pair of disposable gloves.
- Open well cap and make a visual check down the casing and note the condition of the well casing and whether a permanent groundwater level reference point has been established on the casing. Note on respective field log sheet.
- Perform ambient air monitoring for hazardous conditions on a continuous basis following opening of the well using a PID and CGM. Record readings in the field notebook.

### *Groundwater Well Sampling Procedures*

The following method will be used to collect leachate samples:

1. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.
2. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.
3. Place clean plastic sheeting around the well to provide a barrier between the surrounding ground surface and sampling equipment.

4. Groundwater samples will be collected in accordance with RCRA Groundwater Monitoring TEGD guidelines. Using a low-flow sampling system such as the MicroPurge Basic System.
5. Put on a clean pair of disposable gloves.
6. The low-flow pump will be lowered into the well, and the pump intake will be located at the approximate midpoint of the screened interval. Once the pump is in place, the controller will be set for the desired flow rate. The optimum flow rate is dependent on the site-specific hydrogeology and will be determined in the field, however, the flow rate will not exceed 1 L/min.
7. Samples will be transferred from the bailer to appropriate sample containers. Agitation and aeration will be minimal.
8. Fill sample containers for VOC samples prior to filling other sample containers.
9. Fill remaining sample containers.
10. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.
11. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.
12. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.
13. Record the physical appearance of the groundwater observed during sampling on the groundwater sampling log or in the field notebook.
14. Replace the well cap and lock the well protection assembly before leaving the well location.
15. The pump and all downhole equipment will be decontaminated prior to each use.

***Groundwater Borehole Sample Collection***

The following method will be used to collect groundwater samples:

1. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.

2. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.

3. The Geoprobe® will hydraulically push the screened sampler to the desired sample depth (e.g., the first sample will be collected at 20 feet below ground surface). The sampler will fill with groundwater.

4. Send a bailer or ball and check valve down to the screened section of the sampler to collect the groundwater sample. Pull the bailer or ball and check valve to the surface.

5. Unfiltered samples will be collected at each sample location and depth.

6. Fill sample containers for VOC samples prior to filling other sample containers.

7. Fill remaining sample containers.

8. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until filled. Sample containers will be preserved as described in the QAPP.

9. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius using ice. Samples must not be allowed to freeze.

10. The Geoprobe® will then push the screened sampler to the next desired depth (e.g., 60 feet). As before, send either a bailer or ball and check valve down into the sampler to collect the groundwater. Bring the sample to the surface and fill the appropriate sample containers. Continue to repeat this process until all samples have been collected.

11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.

12. Record the physical appearance of the groundwater observed during sampling on the groundwater sampling log or in the field notebook.

# APPENDIX J Rock Lithology, Log Order of Presentation and Selection

# APPENDIX J    Rock Lithology Log Order of Presentation and Selection

## 1. COLOR

Color (from Munsell Color Chart) of logged interval or mass (sample)

## 2. ROCK QUALITY

The rock quality designation (%RQD) is computed in the following way:

%RQD = 100 x [length of core in pieces $\geq$ 4] / [hole length drilled or attempted (cored)]

*Guidelines:*

- Measure from the center of natural breaks
- Exclude joints that dip within 5 degrees of core axis
- Exclude drill breaks (See criteria for identification of drill breaks)
- Do not calculate RQD for soft semi-indurate rock or severely weathered rock ("Weathering" is addressed below)

*Scale:*

| | | |
|---|---|---|
| 90 – 100 | Excellent | Massive |
| 75 – 90 | Good | Lightly fractured |
| 50 – 75 | Fair | Moderately fractured |
| 25 – 50 | Poor | Highly fractured |
| 0 – 25 | Very poor | Sheared |

It is important to think of RQD in conditions of equal effect; that is, group the RQD ranges as equivalent to rock type, structural domain, shear zones, and so forth.

*Criteria for identifying drilling breaks:*

- A rough, brittle surface with fresh cleavage planes in individual rock minerals indicates an artificial fracture
- A generally smooth or somewhat weathered surface with soft coating or infilling materials such as talc, gypsum, chlorite, mica, or calcite obviously indicates a natural discontinuity

## APPENDIX J Rock Lithology Log Order of Presentation and Selection

- In rocks showing foliation, cleavage, or bedding, it may be difficult to distinguish between natural discontinuities and artificial fractures when these are parallel with the incipient planes of weakness. If drilling has been carried out carefully, then the questionable breaks should be counted as natural features, to make the conservative assumption.
- Depending on the drilling equipment, part of the length of core being drilled may occasionally rotate with the inner barrels in such a way that grinding of the surfaces of discontinuities and fractures occurs. In weak rock types, it may be difficult to decide if the resulting rounded surfaces are present natural or artificial features. When in doubt, the conservative assumption should be made; that is, assume that they are natural.
- It is appropriate to keep a separate record of the frequency of artificial fractures for assessing the possible influence of blasting on the weaker sedimentary and foliated or schistose metamorphic rocks.

The occurrence of impurities is qualified with the following terms:

consolidated, unconsolidated, semi-consolidated round, sub-round, sub-angular, angular, ellipsoidal, spherical

| | | |
|---|---|---|
| masses | brecciated | trace remnants |
| pockets | chaotically intermixed | disseminated throughout matrix |
| nodules | fine wispy layers | scattered |
| blebs | stringers | streaks or specks |
| lenses | subtle network | narrow zones |
| oolites | chicken wire pattern | |
| zones | dendritic | |
| transitions | | |

## 3. POROSITY

Use the following descriptions:

none

medium

moderate

very

pinhole porosity

visual porosity

## 4. BEDS

*Bedding*, horizontal or inclined:

planar

mylonitic

folded

contorted

wavy banding

*Bedding, beds, cleavage, and foliation:*

| | |
|---|---|
| Very thin | 1-3 cm (0.4-1") |
| Thin | 3-10 cm (1-4") |
| Medium | 10-30 cm (4"-1') |
| Thick | 30-100 cm (1-3') |
| very thick | >100 cm (>3') |

*Lamina:*

laminated: 0.3-1 cm (0.4-1")

thinly laminated: <0.3 cm (<0.4")

5. **THICKNESS, LAMINATIONS, LAMELLA, SEAMS**

smooth

broken

irregular

convuluted

up/down criteria

6. **CONTACT**

distinct

vague

gradational

7. **FOLIATION**

fissile (planar splitting)

non-fissile

8. **JOINTS**

| | | |
|---|---|---|
| planar | irregular break | infilled with |
| parting planes | scalloped | healed fracture |
| | conchoidal | mylonitic |

*Spacing*

| | |
|---|---|
| Very thin | 1-3 cm (0.4-1") |
| thin | 3-10 cm (1-4") |
| medium | 10-30 cm (4"-1') |
| thick | 30-100 cm (1-3') |
| Very thick | >100 cm (>3') |

## 9. WEATHERING

| | |
|---|---|
| **Fresh** | Rock fresh; crystals or grains bright; a few joints may show slight staining; crystalline rocks ring if struck with a hammer |
| **Slight** | Rock generally fresh; joints stained and may show clay filling if open; staining may extend into rock fabric adjacent to weathered planes; if present, feldspars may be dull and discolored; crystalline rocks ring if struck with hammer |
| **Moderate** | Except for quartz, most of the rock mass shows discoloration and weathering; most feldspar is dull and discolored and kaolinitization (alteration to clay minerals) is common; rock gives a dull sound if struck with hammer; rock shows overall loss of strength; potions may be removed with a geologist's pick |
| **Severe** | All minerals except quartz discolored or stained; rock fabric still discernible; intergranular or intercrystalline disassociation virtually complete; internal structure essentially that of soil; fragments of strong rock may remain; may be called saprolite |
| **Complete** | Rock is decomposed to a soil; fabric not discernible or only barely discernible; quartz may remain as dikes or stringers |

## 10. SURFACE

| | |
|---|---|
| **Solid** | Contains no voids |
| **Pitted** | Small voids generally restricted to joint surfaces, bedding planes, or other surfaces which provide access for attacking fluids |
| **Vuggy** | Use restricted to solution voids in carbonate rocks and hydrothermally altered rocks; voids may be found throughout the rock face; voids up to 9 inch diameter |
| **Vesicular** | Use restricted to voids in igneous (occasionally metamorphic) rocks, void origin usually due to gas bubbles; voids up to 3-inch average diameter |
| **Cavernous** | Applicable in any rock; voids and channels greater than 9-inch average diameter; voids large enough to cause serious leakage or structural problems |

## 11. HARDNESS

The following scale (not to be confused with Moh's scale for hardness of minerals) is used for a rock

| | |
|---|---|
| **Very hard** | Cannot be scratched with knife or sharp pick; breaking of hand specimens require several hard blows of geologist's pick |
| **Hard** | Can be scratched with knife or pick, only with difficulty; hard blow of hammer required to detach hand specimen |
| **Moderately** | Can be scratched with knife or pick; gouges or grooves to 1/8-inch deep can be excavated by hard blow of point of geologist's pick; hand specimen can be detached by moderate blow |
| **Medium** | Can be grooved or gouged 1/16-inch deep by firm pressure on knife or pick point; can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick |
| **Soft** | Can be gouged or grooved readily with knife or pick point; can be excavated in chips to pieces several inches in size by moderate blows of a pick point; small thin pieces can be broken by finger pressure |
| **Very soft** | Can be carved with knife; can be excavated readily with point of pick; pieces 1-inch or more in thickness can be broken by finger pressure; can be scratched readily by fingernail |

## 12. TEXTURE

American Geological Institute data sheets

| | |
|---|---|
| Fine | <1 mm |
| Medium | 1 5 mm |
| coarse | >5 mm |

## 13. GRAIN SHAPE

very angular

angular

sub-angular

sub-rounded

rounded

well rounded

## 14. SORTING (for sedimentary rocks)

very well sorted

well sorted (poorly graded)

moderately sorted

poorly sorted (well graded)

very poorly sorted

## 15. MINERAL COMPONENTS

## 16. ROCK CLASSIFICATION

American Geological Institute data sheets

Abbreviations of rock descriptions will conform to the standard abbreviation list. This list is presented below. A word that is not on this list will be spelled out. An initial capital letter will be used for each rock type. Capital letters will be for formation names and rock types.

Punctuation will also be standardized. The following convention will be used for punctuation:

- Comma after each item of description
- Semi-colon between each rock-type description
- No full stops (periods).

In addition, remarks such as *A/A* ("as above"), *same as above*, *see above*, or *same* are undesirable.

# APPENDIX J — Rock Lithology Log Order of Presentation and Selection

*Accepted abbreviations:*

| | |
|---|---|
| **A** | |
| about | ABT |
| above | ABV |
| abundant | ABDT |
| accumulation | ACCUM |
| acicular | ACIC |
| aggregate | AGG |
| agglomerate | AGLM |
| algae | ALG |
| altered | ALT |
| amorphous | AMOR |
| amount | AMT |
| angular | ANG |
| anhedral | ANHED |
| anhydrite | ANHY |
| anhydritic | ANHYDRIC |
| apparent | APR |
| appears | APRS |
| approximate | APPROX |
| aragonite | ARAG |
| arenaceous | AREN |
| argillaceous | ARG |
| arkose | ARK |
| asphalt | ASPH |
| at | @ |
| average | AV |

| | |
|---|---|
| bed | BED |
| bedded | BEDD |
| bedding | BEDG |
| bentonite | BENT |
| biotite | BIOT |
| bitumen | BIT |
| black | BLK |
| bleeding | BLDG |
| blocky | BLKY |
| botryoida | BTRI |
| bottom | BTM |
| boulder | BLDR |
| brachiopod | BRAC |
| breccia | BREC |
| brittle | BRIT |
| bright | BRI |
| broken | BRKN |
| brown | BRN |
| bryozoa | BRY |
| | |
| **C** | |
| calcite | CA |
| calcareous | CALC |
| carbonaceous | CARB |
| cavernous | CAV |
| caving | CVG |
| cement | CMT |

## APPENDIX J — Rock Lithology Log Order of Presentation and Selection

| | |
|---|---|
| **B** | |
| band | BND |
| banded | BNDD |
| barite | BAR |
| basalt | BAS |
| chitin | CHIT |
| chlorite | CHL |
| chloritic | CHLTC |
| clastic | CLAS |
| clay | CLY |
| claystone | CLYST |
| clean | CLN |
| clear | CLR |
| cleavage | CLV |
| cluster | CLS |
| coal | COAL |
| coarse | C |
| cobble | CBL |
| color | COL |
| common | COM |
| compact | COMP |
| conchoidal | CONCH |
| concentric | CNCN |
| conodont | CONO |
| conglomerate | CGL |
| contact | CONT |
| contorted | CONTRT |
| coquina | COQ |
| covered | COV |

| | |
|---|---|
| center | CNTR |
| cephalopod | CEPH |
| chalcedony | CHAL |
| chalk | CHK |
| chert | CHT |
| determine | DTRM |
| detrital | DTRL |
| diameter | DIAM |
| diatoms | DIAT |
| difference | DIF |
| disseminated | DISM |
| dolocast | DOLC |
| dolomite | DOL |
| dolomitic | DOLIC |
| dolomoid | DOLM |
| drusey | DRSY |
| | |
| **E** | |
| earthy | ETHY |
| echinoid | ECH |
| eliptical | ELIP |
| elongate | ELNG |
| embedded | EMBEDD |
| enlarged | ENL |
| epidote | EP |
| equivalent | EQUIV |
| euhedral | EUHED |
| evaporitic | EVAP |
| expose | EXP |

## APPENDIX J Rock Lithology Log Order of Presentation and Selection

| | |
|---|---|
| cream | CRM |
| crenelated | CREN |
| crevice | CREV |
| crinkled | CRNK |
| crinoid | CRIN |
| crossbedded | XBEDD |
| crosslaminated | XLAM |
| cross-stratified | XSTRAT |
| cryptocrystalline | CRPXLN |
| cryptograined | CRPGR |
| crystal | XL |
| crystalline | XLN |
| cuttings | CTGS |
| | |
| **D** | |
| dark | DK |
| dead | DD |
| debris | DEB |
| degree | DEGR |
| dendritic | DEND |
| dense | DNS |
| formation | FMTN |
| fossil | FOSS |
| fossiliferous | FOSSIF |
| fracture,-ed | FRAC |
| fragment | FRAG |
| fresh | FRSH |
| friable | FRI |
| frosted | FROS |

| | |
|---|---|
| extrusive | EXTRU |
| | |
| **F** | |
| faceted | FAC |
| faint | FNT |
| fair | R |
| fault | FLT |
| fauna | RAU |
| feldspar | FELS |
| ferruginous | FE |
| fibrous | FIB |
| figured | FIG |
| fine,-ly | F |
| fissile | FISS |
| flaggy | FLGY |
| flake,-y | FLK,-Y |
| flinty | FLTY |
| floating | FLTG |
| fluorescence | FLUOR |
| foliated,-ion | FOL |
| foraminifera | FORAM |
| **I** | |
| igneous | IG |
| imbedded | IMBEDD |
| impregnated | IMPRG |
| impressions | IMP |
| included | INCL |
| inclusion | INCLSN |
| increase | INCR |

# APPENDIX J

## Rock Lithology Log Order of Presentation and Selection

| | |
|---|---|
| fusilinid | FUS |
| | |
| **G** | |
| gabro | GAB |
| gastropod | GAST |
| glassy | GL |
| glauconite | GLAUC |
| globular | GLOB |
| gloss | GLOS |
| gneiss | GN |
| good | G |
| grade | GRD |
| grading | GRDG |
| grain | GRN |
| granite | GRNT |
| granular | GRAN |
| granule | GRNL |
| graptolite | GRAP |
| gravel | GVL |
| gray | GRY |
| graywacke | GYWKE |
| greasy | GRSY |
| green | GREEN |
| gritty | GRTY |
| gypsum | GYP |
| gypsiferous | GYPS |
| | |
| **H** | |
| hard | HD |
| indistinct | IND |
| interbedded | INTBEDD |
| intercrystalline | INTXLN |
| intergranular | INTGRAN |
| intergrown | INTGWN |
| interlaminated | INTLAM |
| interstitial | INTSTL |
| interval | INTVL |
| intraformational | INTRM |
| intrusion | INTR |
| invertebrate | INVRTB |
| iron | FE |
| iron oxides | FE-OX |
| ironstone | FE-ST |
| irregular | IREG |
| iridescent | IRID |
| | |
| **J** | |
| jasper | JASP |
| jointed | JTD |
| jointing | JTG |
| joints | JTS |
| | |
| **K** | |
| kaolin,-ite | KAOL |
| | |
| **L** | |
| laminated | LAM |
| large | LRG |

# APPENDIX J Rock Lithology Log Order of Presentation and Selection

| | |
|---|---|
| heavy | HVY |
| hematite | HEM |
| high | HI |
| horizontal | HOR |
| hornblende | HBD |
| hydrocarbon | HYDC |
| | |
| limonite | LMNT |
| limy | LMY |
| lithic | LITH |
| lithographic | LITHG |
| little | LTL |
| long | LONG |
| loose | LSE |
| lower | LOW |
| lumpy | LMPY |
| luster | LSTR |
| | |
| **M** | |
| macro-fossil | MACFOS |
| magnetic | MAGN |
| magnetite | MAG |
| marl | ML |
| marlstone | MRLST |
| maroon | MAR |
| massive | MASS |
| material | MAT |
| matrix | MTX |

| | |
|---|---|
| lavender | LAV |
| layer | LYR |
| leached | LCHD |
| ledge | LDG |
| lenticular | LENT |
| light | LT |
| lignite | LIG |
| limestone | LS |
| numerous | NUM |
| | |
| **O** | |
| object | OBJ |
| occasional | OCC |
| ocher | OCH |
| odor | ODOR |
| oil | OIL |
| olive | OLV |
| oolitic | OOL |
| opaque | OPG |
| opposite | OPP |
| orange | ORNG |
| organic | ORG |
| orthoclase | ORTH |
| ostracod | OST |
| oxidized | OX |
| | |
| **P** | |
| patchy | PCHY |
| part | PT |

# APPENDIX J — Rock Lithology Log Order of Presentation and Selection

| | | | |
|---|---|---|---|
| maximum | MAX | parting | PTG |
| medium | M | pearl | PRL |
| member | MBR | pebble | PBL |
| metamorphic | METAM | pegmatite | PEG |
| mica | MIC | pelecypod | PLCY |
| micaceous | MICAC | pellet | PEL |
| microcrystalline | MICXLN | permeability | PERM |
| microfossil | MICFOS | petroleum | PET |
| micrograined | MICGR | phosphate | PHOS |
| micromicaceous | MMIC | pink | PNK |
| middle | MID | pinpoint porosity | PPP |
| mineral | MNRL | pisolite | PISO |
| minimum | MIN | pitted | PIT |
| minor | MNR | plagioclase | PLAG |
| minute | MNUT | plant fossils | PL FOS |
| moderate | MOD | plastic | PLAS |
| mollusca | MOL | platy | PLTY |
| mottled | MOT | polish | POL |
| mudstone | MDST | poor | PR |
| muscovite | MUSC | porcelaneous | PORC |
| | | porosity | POR |
| N | | porphyry | PORPH |
| nacreous | NAC | possible | POS |
| nodule | NOD | predominant | PRED |
| preserved | PRES | scattered | SCAT |
| primary | PRIM | schist | SCH |
| prismatic | PRIS | scolecondonts | SCOL |
| probably | PROB | secondary | SEC |
| prominent | PROM | sediment | SED |

## APPENDIX J Rock Lithology Log Order of Presentation and Selection

| | |
|---|---|
| pseudo | PSDO |
| purple | PURP |
| pyrite | PYR |
| pyrobitumen | PYRBIT |
| pyroclastic | PYRCLAS |
| | |
| **Q** | |
| quartz | QTZ |
| quartzite | QTZT |
| quartizitic | QTZTC |
| quartzose | QTZS |
| | |
| **R** | |
| radiate | RAD |
| range | RNG |
| random | RAND |
| rare | RR |
| red | R |
| regular | REG |
| remains | RMN |
| replaced | RPL |
| residue | RESD |
| resinous | RSNS |
| rhombohedral | RHMB-L |
| rock | RK |
| round | RND |
| rounded | RNDD |
| rubbly | RBLY |
| rusty | RST |

| | |
|---|---|
| selenite | SEL |
| sericite | SER |
| severe | SEV |
| shale,-ly | SH,SHY |
| siderite | SID |
| silica | SIL |
| sillceous | SILIC |
| silky | SLKY |
| silt | SLT |
| siltstone | SLTST |
| size | SZ |
| slickensided | SLKS |
| slight | SL |
| small | S |
| smooth | SMTH |
| soft | SFT |
| soluble | SOLB |
| solution | SOL |
| sort | SRT |
| speck | SPCK |
| sphalerite | SPHAL |
| spherules | SPH |
| spicule | SPIC |
| splintery | SPL |
| sponge | SPG |
| spore | SPR |
| spot | SP |
| stain | STN |
| stained | STND |

# APPENDIX J Rock Lithology Log Order of Presentation and Selection

| | |
|---|---|
| **S** | |
| salt | SALT |
| saccharoidal | SACC |
| sample | SMPL |
| sand | SD |
| sandstone | SS |
| sandy | SDY |
| saturated | SAT |
| scales | SC |
| scarce | SCS |
| sucrose | SUC |
| sulphur | SULF |
| surface | SURF |
| | |
| **T** | |
| tabular | TAB |
| texture | TEX |
| thick | THK |
| thin | THN |
| through | THRU |
| tight | TT |
| tourmaline | TOUR |
| trace | TR |
| transparent | TRNSP |
| trilobite | TRILO |
| tripolitic | TRIP |
| tubular | TUB |
| tuff | TUFF |

| | |
|---|---|
| staining | STNG |
| stippled | STIP |
| strata | STRAT |
| streak | STR |
| striated | STRI |
| stringer | STRG |
| stromatoparoids | STROM |
| structure | STRUC |
| styolite | STYL |
| subangular | SUBANG |
| subhedral | SUBHED |
| **W** | |
| water | WTR |
| wavy | WVY |
| waxy | WXY |
| weather | WTHR |
| weathered | WTHRD |
| white | WH |
| with | W/ |
| | |
| **Y** | |
| yellow | YEL |
| | |
| **Z** | |
| zone | ZN |

| | |
|---|---|
| U | |
| unconformity | UNCONF |
| unconsolidated | UNCONS |
| upper | UP |
| | |
| V | |
| variable | VAR |
| varicolored | VCOL |
| variegated | VGTD |
| varved | VRVD |
| vein | VN |
| vertebrate | VRTB |
| very | V |
| vesicular | VES |
| vitreous | VIT |
| volcanics | VOLC |
| vug,-gy,-ular | VUG |

# APPENDIX K

# Slug Test Field Log

# APPENDIXK — Slug Test Field Log

**Standard Operating Procedure (SOP) for *In Situ* Hydraulic Conductivity Tests (Slug Tests)**

### *Equipment Requirements*

- A pressure transducer connected to a data logger system
- An inert solid slug of sufficient diameter and length to artificially raise or lower the water level 1 foot or more in the well (commonly either a PVC or Teflon® slug)
- A timing device

### *Test Design*

1. Identify the test objectives and document them.
2. Identify potential limitations of test and interpretation methods as they relate to the project and site.
3. Identify the available database for correlation purposes (other hydraulic conductivity test data, maps, or logs of subsurface soils).
4. Evaluate access to wells and obstructions or siltation in wells.
5. Review boring and well completion logs for wells to be tested for lithology, natural discontinuities, possible well yield, screen length, location of groundwater table with respect to the screen interval, and type of sand/gravel pack.
6. Identify the type of in situ hydraulic conductivity test to be used.
   - Only use a rising head test if the screened interval of the well straddles the water table. The introduction of water into the unsaturated portion of the formation during a falling head test will result in an inaccurate estimation of hydraulic conductivity.
   - If the screened interval of the well is fully submerged below the water, use both the rising and falling head test and average the results.
7. Evaluate the amount of head change to be induced in the well.
8. Evaluate the water level measurement frequency needed.
   - During the early portions of the test, measure water levels as closely spaced intervals. The frequency of measurements will be governed by the rate of recovery of the water level in the well. The faster the recovery, the more frequently the measurements need to

be taken. Measurement frequency can decline logarithmically during the test (the length of time between measurements increasing during the test). Water levels should be recorded until the water level has recovered to 95% of static pre-test conditions.

9 Identify the type of slug and water level recording device to be used.

- Choose the manual or electronic method based upon previously calculated hydraulic conductivity (K) values or expected K based upon grain size encountered within the well:
- If $K > 10^{-3}$ cm/sec, use pressure transducer
- If $K < 10^{-3}$ cm/sec, use pressure transducer or manual method

***Field Protocols***

1 Record the following information in the project notebook and the slug test field log at the end of this appendix:

- Name
- Date
- Project name and description
- Project number
- Well number and well location in sufficient detail to relocate

2 Measure and document static head. If a pressure transducer is to be used, lower transducer into well, and secure the pressure transducer cable to the well to prevent movement. Connect the pressure transducer to the electronic data logger. Measure the static head with both the transducer and manually, then start the automatic recording by the data logger.

3. Insert the slug into or withdraw the slug from the groundwater in the well.

- Given the variability of test conditions, there is no absolute requirement for the magnitude of the change in water level. It is suggested that a minimum of 1-foot instantaneous hydraulic head change be created to allow for effective measurement of aquifer response. About 75% of the estimated displacement by the slug should be documented in the water level recordings.

4. Measure the recovery of the water level in the well until 95% recovery to static conditions has been achieved.

- For manual measurements, record the time (real or elapse time) and the depth to groundwater in the well in the project field book. All measurements should be from the same point on the well casing using the same well probe.
- For the pressure transducer, the time and water level will be automatically recorded.

5. Data Review

   a. Make sure the necessary information is documented for each test within the field notebook and on a slug test field log.

   b. Make a preliminary analysis of data before leaving the field to evaluate if test was successful:

- Did the slug create an instantaneous head change in the well of sufficient magnitude to observe a meaningful water level response?
- Did you collect a sufficient number of data points to define the water level recovery for the test?
- Is the test data generally consistent with your pre-test expectations?
- If the test was not successful, re-evaluate the test design and complete a new test.

   c. For electronic tests, copy the data file onto a disk and label the disk with the project number, date, test well, and file name.

Sauget Area 2 Site
Slug Testing Form
URS Job No. 23-20010024.02

Monitoring Well - ______________ Date: ____________
Diameter - two inches
Total Depth - __________ feet below top of casing
Screened Interval - ________ feet to _________ feet below top of casing
Length of Water Column - __________ feet
Circle one Slug In / Slug Out

| Time (min:secs) | Depth to Water (feet) | | Time (min:secs) | Depth to Water (feet) | | Time (min:secs) | Depth to Water (feet) |
|---|---|---|---|---|---|---|---|
| 0:02 | | | 1:20 | | | 8:30 | |
| 0:04 | | | 1:30 | | | 9:00 | |
| 0:06 | | | 1:40 | | | 9:30 | |
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# APPENDIX L

## Air Sampling Methods

# APPENDIXL Air Sampling Methods

Standard Operating Procedures will be developed and provided for the air sampling and analysis program upon selection of the laboratories who will perform these services.

# APPENDIX M

# Stormwater Runoff and Seep SOP

# APPENDIX M — Stormwater Runoff and Seep SOP

The following method will be used for collection of storm water samples:

1. Identify the primary storm water drainage route, running from the site to the Mississippi River. Figures 7 and 9 of this FSP present approximate storm water sampling locations for sites R and Q respectively.
2. Collect the sample during a rainfall which results in a discharge. A storm water sample will be collected during three separate storm events (for a total of three samples per site).
3. Use an automated storm water sampler to collect a first flush sample.
4. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.
5. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection, except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.
6. Put on a clean pair of disposable gloves.
7. Fill sample containers for the VOC sample, prior to filling other sample containers. Verify that there is no air in the sealed sampled container.
8. Transfer the water from the sampler to sample containers provided by the laboratory.
9. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.
10. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.
11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.
12. Record the physical appearance of the storm water observed during sampling in the field notebook.

The owners manual for two automated samplers is provided in this Appendix.

# APPENDIX M  Stormwater Runoff and Seep SOP

The following method will be used for collection of seep water samples:

1. Identify the seep location(s) along the riverbank and note location.
2. Remove appropriate sample containers from the transport container, and prepare the sample containers for receiving samples.
3. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container. Place clear polyethylene tape over the completed label to protect it from dirt and water. Sample labels can be prepared prior to sample collection, except for time and date. Labels can be filled in on the date of sample collection and just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples
4. Grab sampling procedures and preservation of the collected seep water samples will follow the methods described in the current edition of "Standard Methods for the Examination of Water and Wastewater" (published by the American Public Health Association).
5. Put on a clean pair of disposable gloves.
6. Use a dipping utensil to retrieve a sample.
7. Fill sample containers for the VOC sample, prior to filling other sample containers. Verify that there is no air in the sealed sampled container.
8. Fill remaining sample containers
9. If the sample containers cannot be filled quickly, keep sample containers cool with the cap on until finished. Sample containers will be preserved as described in the QAPP.
10. Return each sample container to its proper transport container. Preserve samples by reducing the temperature within the containers to approximately 4° Celsius, using ice. Samples must not be allowed to freeze.
11. Begin chain-of-custody procedures. A sample chain-of-custody form is included in Appendix F.
12. Record the physical appearance of the storm water observed during sampling in the field notebook.

# Global Water
# Stormwater Sampler
# SS201

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# Global Water
# Stormwater Sampler
# Instruction Manual

# Global Stormwater Sampler



**Description**

The Global Stormwater Sampler is designed specifically to meet the sampling requirements of the Stormwater program. The Global Sampler takes a "first flush" sample in one bottle and a "time weighted" composite sample in the second bottle, to meet the guidelines. It is actually two samplers in one: it consists of two intake tubes, two sampling pumps and two bottles, which eliminates any possiblity of cross contamination between the first flush and the composite sample. The Global Stormwater Sampler is easily set up and installed in any stormwater channel to take and store physical water samples throughout the storm event.

The Global Stormwater Sampler consists of a rugged, rainproof lockable carrying enclosure. Inside the enclosure are two 4000 ml polyethylene sample bottles for first flush and composite samples, two peristaltic sampling pumps, the logic timer/controller, the water sensor, and a rechargeable gel cell battery. Also provided is the rain gauge, two sample pickup hoses and a battery charger. Everything you need is provided for a successful sampling program.

*Low Power:* The internal rechargeable battery will power the sampler for several months and/or for several storm events.

*Overflow Protection:* Each sample bottle is equipped with a float switch which automatically turns off the sampler pump if the bottle becomes full. Be sure the electrical leads from the bottle caps are plugged into the jacks on the bottom of the controller housing.

*Environmental:* The Sampler is not damaged by water or moisture or severe environmental conditions. All parts may be washed with soap and water.

*Operating Temperature:* 0 to 70 degrees C

**Specifications**

*Sample Size:*

First Flush: 4000 ml

Composite: 200 ml at 10 minute intervals, or set by user. 4000 ml composite sample maximum.

*Size:* 9" L X 17" W X 22" H

*Weight:* 22 # (Shipping Weight 24#)

*Materials:*

Enclosure: Expanded UV protected PVC
Bottles: 4000 ml polyethylene
Sample Tubing: Polyethylene

*Sample Pumps:*

Flow Rate: 1000 ml per minute at 4 ft. head
Type: Peristaltic
Maximum Lift: 22'

*Logic Timer/Controller:* CMOS Solid State (fully potted in epoxy).

*Water Level Sensor:* Solid State with a 15' cable.

*Sample Hoses:* Two 15' nylon reinforced 1/4" ID polyethylene flexible tubing sections with intake strainers. Hoses may be extended, as required, using standard 1/4" tubing and fittings.

*Battery:* Rechargeable2 AH Gel Cell

*Battery Life:* The battery will power the sampler for a minimum of four months including five 24-hr. storm events before recharging is required.

**Sampler Operation**

The Global Stormwater Sampler is shipped fully assembled and tested. Remove everything from the box and straighten out the hoses.

1. *Set the Sampler in an upright position.* (It will not work if it is on its side.)

2. Be sure the water sensor is plugged into its jack on the lower right side of the control panel.

2. Check to be sure the two float switches in the bottle cap are properly connected. Plug the lead from the bottle cap into the socket on the bottom of the controller housing.

The Global Stormwater Sampler is controlled by the water sensor. Plug the sensor into the jack on the lower right side of the control panel. The water sensor can be used to trigger the sampler based on rainfall *or* raise in water level in the storm drain. For rainfall triggering, position the water sensor in the inner tube of the rain gauge. Adjust the height of the two sensor electrodes to the amount of rainfall you want before samples are taken. (For example, if you want 0.1" rain before samples are taken, adjust the sensor so the bottom to the electrodes is opposite the 0.1" marking on the inner cylinder.) See separate instruction sheet for rain gauge installation and operation. For triggering based on water level, position and secure the water sensor in the channel at a point of depth where you want the sampler to start operation.

After the water sensor touches the water (in either the rain gauge or storm drain) the sampler pump is activated. The first flush will run until the bottle is full and then the float switch in the bottle cap will turn off the Sampler. Normally, the composite sampler side is set (by the user—it is not set in the factory) to take a 200 ml sample every 10 minutes until the composite sample bottle is full. The sample size and sampler interval are fully adjustable by using the knobs on the upper right side of the control panel.

Open the Sampler enclosure and remove the battery charger. The battery is installed in the controller enclosure. On the right side of the controller enclosure, find the on-off toggle switch. Push the switch up, for ON. This turns on the battery power to the Sampler. Press the push button on the right side to activate the right side sampler pump. Press the left side button to activate the left side pump. Use these buttons to verify system operation, to take manual samples, and to remove sample water from the hoses after a storm event.

If the pumps grind slowly, this is an indication that it is time to recharge the battery. Also, before any extended use, it is a good idea to recharge the battery. Plug the charger into the charger socket, on the left side. *Then* plug the charger into the wall socket. Charge for 12 hours for a full recharge.

The sample size is approximate and varies with vertical distance between the water and the Sampler. For precise sample size, you may want to verify sample size and adjust for your specific installation.

After the storm, remove the sample bottles and take the samples to your lab for analysis. Run the sampler pump to remove old water from the lines and then install a clean empty bottle. Be sure to plug the lead from the bottle cap into the socket on the bottom of the controller housing. The battery is good for several storms between recharging.

## Maintenance

The Global Stormwater Sampler should require no maintenance for several years except routine cleaning with soap and water, and battery recharging.

## Warranty

The Global Stormwater Sampler is warranted to be free of defects for one year after purchase. If you have a problem, please call the factory for return authorization and then ship the unit prepaid. We will repair or replace the unit, and return it to you freight prepaid.


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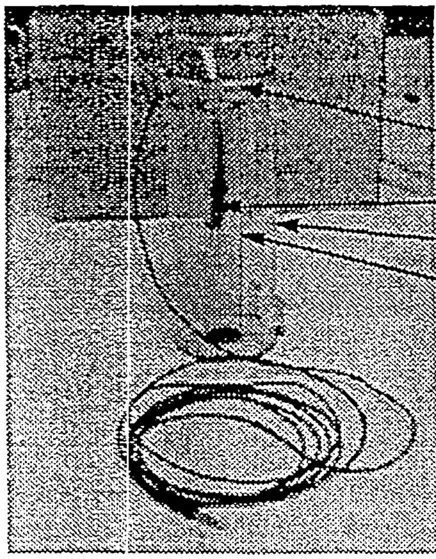
# Rain Gauge Installation and Operation

The Rain Gauge is a precision weather instrument. With minimal care it should provide years of satsfactory service. Guard against extremely rough usage. Wash periodically with mild soap or detergent and warm water, using a household bottle brush. Do not use solvents or abrasives to clean the gauge and do not wash the gauge in your dishwasher. Do not allow accumulated water to freeze in the gauge.




**Installation:**
Mount the gauge on a post that you walk past each day so you will be reminded to read and empty the gauge daily. Ideally the post should be a 4" x 4," or use 2-2 x 4" nailed together. Where possible do not mount near buildings or trees that would prevent rainfall from reaching the gauge. The gauge should be mounted so the top of the gauge is level and is about 6" higher than the top of the post.

**Operation:**
The top funnel catches the rain and delivers it to the measuring tube. The measuring tube has a capacity of 1.00 inch. Rainfalls of less than one inch can be read directly from the measuring tube. Stand the measuring tube on a level surface. Read the amount to the nearest 100th of an inch. Record the rainfall in your log and discard the rain water.

If rainfall exceeds 1 inch, the excess flows into the outer cylinder. To measure, empty the measuring tube containing the first 1.00 inch. Place in the funnel into the measuring tube, then carefully pour the excess rainwater until the outer cylinder is empty. Then record the amount measured in your log. Be sure to count the first inch of rain water that was in the measuring tube. In fact it's a good idea to measure precipitation from heavy rains twice to insure accuracy. Just use an empty can or pan to receive the measured rain water and measure again.

In colder weather use only the outer cylinder to catch hail, sleet, or snow. Melt the snow indoors. Then, using the measuring tube, measure the moisture content of the snow. You may also use the outer cylinder to get a measure of moisture of accumulated snow by pressing the cylinder into a level area of snow then melting the captured snow. Also, you may add a known amount of hot water to speed up the melting process. Then measure the resultant water and subtract the amount of water you added.

**Daily Log:**
Whenever possible, take your readings at the same time each day. Record your readings on the daily log. Use the date on which you take the reading even though much or all of the rain may have fallen the preceding day, after you had already taken your daily reading. Enter your reading in hundredths of an inch (.01, .31, 1.01. 3.01). If the rainfall is less than 0.1 enter "T" for trace in your daily precipitation log.

# Stormwater Sampler Rain Gauge Daily Log

1. Try to record precipitation each day at the same time.
2. Record precipitation to the nearest 1/100 of an inch. (.01, .31. 1.31, etc.)
3. If precipitation is less than .01, record "T" for Trace.
4. Use the remarks column to list any unusual weather.

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Global Water *Sensors • Samplers • Systems*

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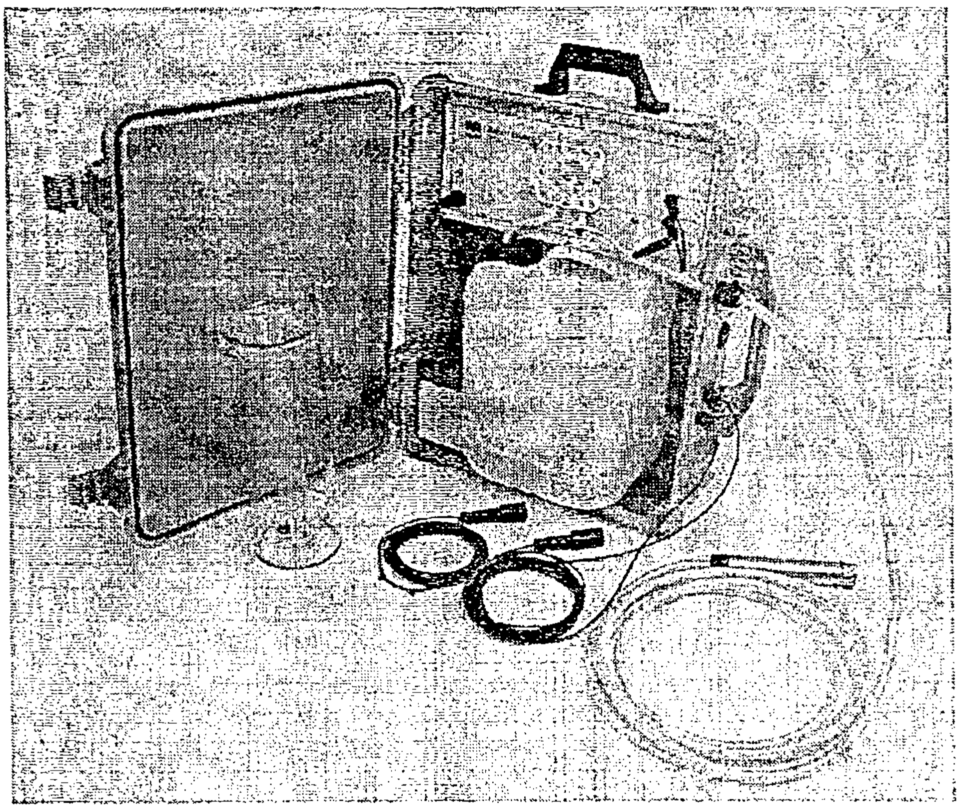
# SS101 Stormwater Sampler

User's Manual



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| Global Water Warranty | 11 |


## Appendices


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| Accessories | A-2 |
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# Specifications

Sample Size: Approximately 2.5 liters.

Sample Pump:
- Flow Rate: 1,000 ml per minute at 4 ft. head.
- Type: Peristaltic
- Maximum Lift: 22'

Size: 9" L x 17" W x 22" H

Operating Temperature: 0 to 70 deg. C

Weight: 22 lbs. (Shipping Weight 24 lbs.)

Materials:
- Enclosure: Expanded UV protected PVC
- Bottle: 4000 ml polyethylene
- Sample Tubing: Polyethylene

Logic Timer/Controller: CMOS Solid State (fully potted in epoxy).

Water Sensors: Solid State with a 15' cable.

Sample Hose: 15' nylon reinforced 1/4" ID polyethylene flexible tubing sections with intake strainers. Hoses may be extended, as required, using standard 1/4" tubing and fittings to a maximum of 50'

Battery: Rechargeable 5 AH Gel Cell. Battery charger included.

Battery Life: The battery will power the sampler for a minimum of four months including five 24-hr. storm events before recharging is required.



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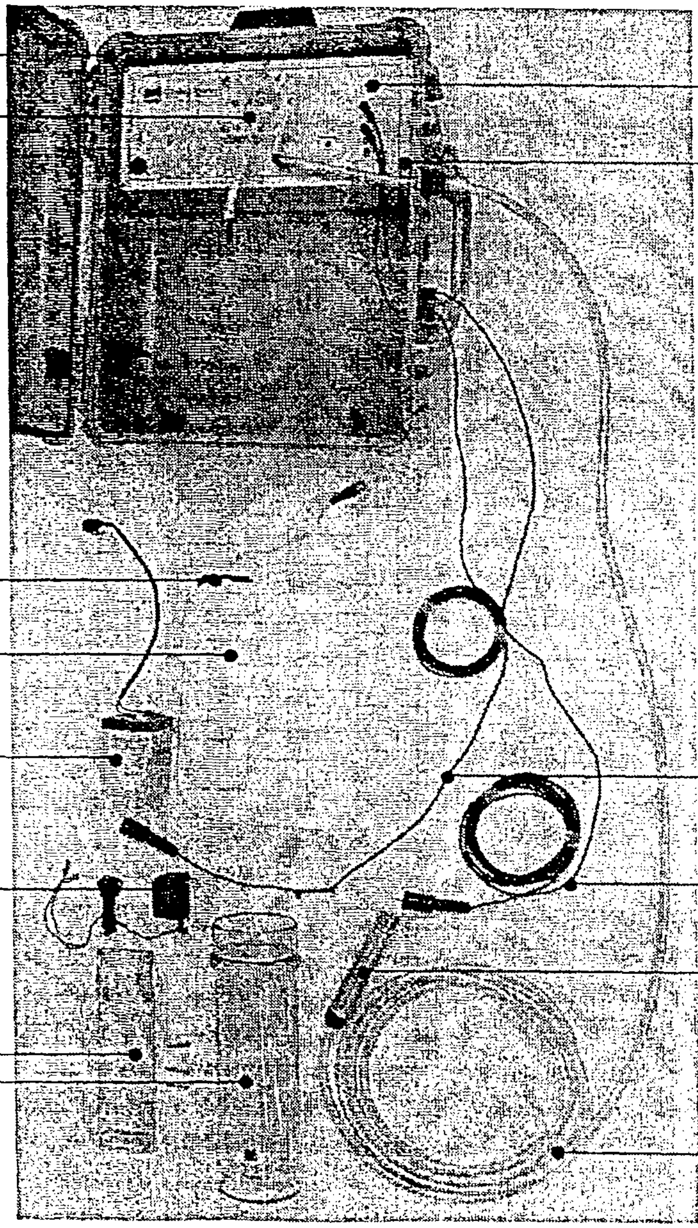
## Product Description

The Global Water SS101 Stormwater Sampler is easily installed near any storm water channel and can store water samples throughout a storm event. The Sampler takes a discrete sample in one bottle based on rainfall accumulation and/or rise in storm water level.

The Global Water SS101 Stormwater Sampler consists the following parts to ensure a successful sampling program:



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# Installation

## Sampling Location

To meet specific permitting requirements, sampling locations may need to be established and certified by a licensed professional- refer to your permitting requirements prior to establishing a sampling program. An appropriate sampling location will most likely be:

- close to a storm water discharge channel or stream,
- situated so the rain gauge is away from trees and buildings, and
- removed from public areas.

### Georgia's NPDES Permit Sampling Location Requirements

The Permit discusses sampling location requirements for the following construction projects:

- For all sites and common developments other than linear construction projects, all waters into which storm water flows, or all storm water channels, or a combination thereof must be sampled.
- For linear construction projects, all perennial and intermittent streams and other water bodies shown on a current 7.5 minute USGS topographic map and all other field verified streams, storm water channels, and water bodies must be sampled. However, representative streams, water bodies, and storm water channels may be sampled.


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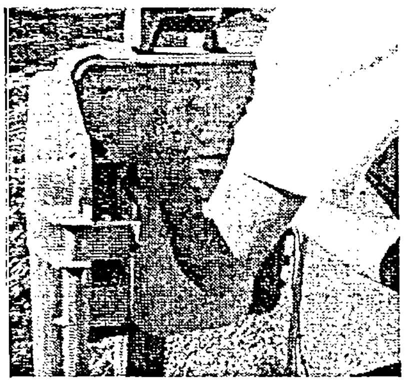
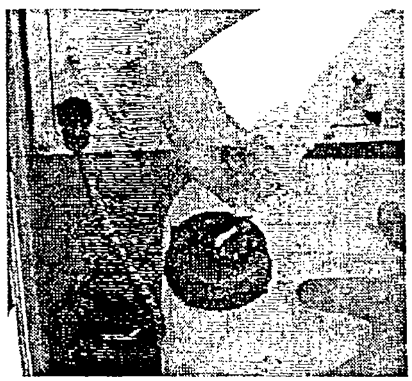
## Sampling Unit

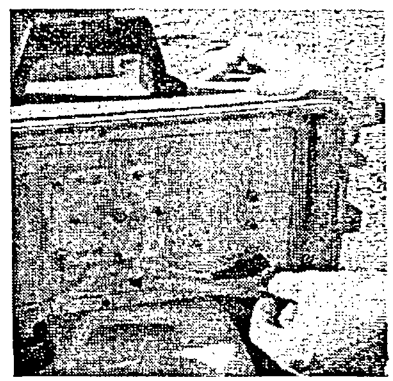
The sampler should be placed upright (it will not work if placed on its back or side) within 15 feet from both the rain and water sensors (see installation instructions below). The battery lead should be securely fastened to the appropriate connection.

To secure the sample bottle:

1) tighten the bottle cap,
2) place bottle into the sampler enclosure,
3) insert end of peristaltic pump hose into hole in bottle cap, and
4) plug the lead from the bottle cap into the "Bottle SW" socket on the control panel.


Place sample bottle into the carrying enclosure.

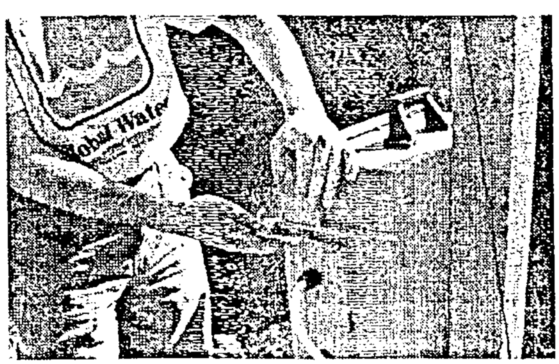

Insert end of peristaltic pump hose into the hole in bottle cap.


Plug the lead from bottle cap into "Bottle SW" socket.

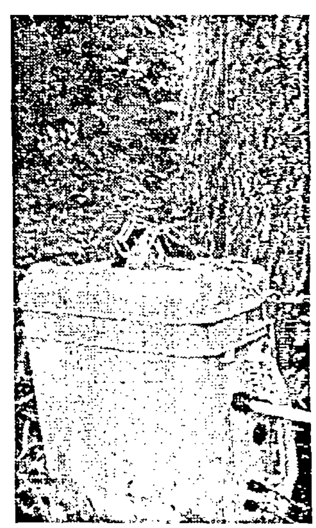
The sampling unit can be secured from vandalism and strong winds by one of the following methods:

- mount unit on post and lock closed,
- lock closed and chain rugged handle to a solid structure (such as a tree, post, or building), or
- enclose and lock unit in a steel electrical box.


The sampling unit can be mounted onto a post.



Lock the carrying enclosure closed to ensure security.


The sampling unit can be chained to a solid structure.



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## RAIN GAUGE

Mount the Global Water Rain Gauge on a post. Ideally, the post should be 4" x 4". Install or use an existing post that is located conveniently for daily readings. Do not mount the rain gauge near buildings or trees that may prevent rainfall from reaching the gauge.

The Rain Gauge should be mounted near eye-level. The top of the rain gauge should be higher than the top of the post. To install the rain gauge:

1) screw the mounting bracket onto the post, making sure the bracket is level,
2) insert the measuring tube into the rain gauge,
3) slide the rain gauge into the mounting bracket,
4) insert the rain sensor to desired rainfall depth (see installation instructions below), and
5) place the top funnel on the unit.


Install a 4" x 4" post that is located conveniently for daily readings.


Screw the mounting bracket onto the post, making sure the bracket is level.


Slide the rain gauge into the mounting bracket.

**Georgia's NPDES Permit Sampling Requirements**

According to the Permit, runoff must be sampled for the following events:
- First rainfall event greater than or equal to 0.5 inches in 24 hours;
- Any rainfall event greater than or equal to 1.0 inches in 24 hours (but only one event per month needs to be sampled until final stabilization);
- Any rainfall event greater than or over 2.0 inches in 24 hours until final stabilization;
- One rainfall event greater than or equal to 0.5 inches in 24 hours after final stabilization; and
- If Best Management Practices have not been properly designed, installed or maintained in accordance with the Permit, any rainfall event greater than or equal to 0.5 inches in 24 hours.


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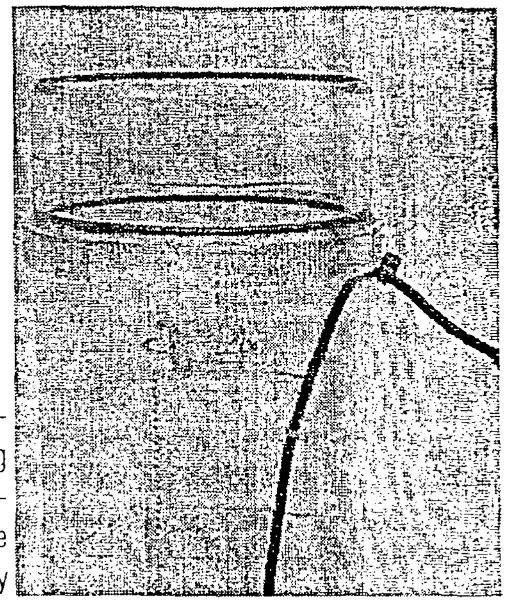
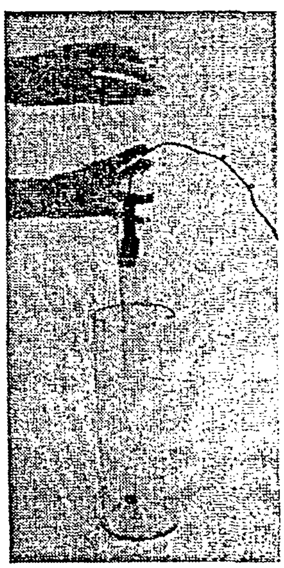
The rain sensor is used to trigger a sample for specific amounts of rainfall accumulation. Based on your application's requirements, insert the tip of the rain sensor into the rain gauge at a specified rainfall accumulation (0.1 to 0.6, 1.0, or 2.0 inches). Securely hook the rain sensor's cable into the groove in the cylinder and place a tie wrap (provided on the cable) outside the groove to secure the installation. Place the Rain Gauge funnel over the cylinder. Insert the rain sensor's plug into the "Rain Sensor" socket on the control panel.



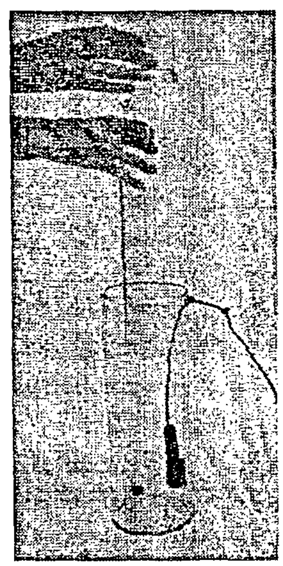
Hook the sensor's cable into the Rain Gauge's groove, securing a tie wrap outside the groove.

To trigger a sample when rainfall from 0.1 to 0.6 inch accumulates, insert the sensor at an appropriate depth into the measuring tube (inside cylinder). To trigger a sample when rainfall accumulates at 1.0 or 2.0 inches, insert the sensor at the appropriate depth in the outer cylinder. For your reference, 0.5" is clearly marked on the inside measuring tube, and 1.0" and 2.0" are clearly marked on the outside cylinder.



To trigger a sample when rainfall at 0.5 inch accumulates, insert the sensor into the measuring tube (inside cylinder) at the depth as marked.

To trigger a sample when rainfall accumulates at 1.0 inch, insert the sensor in the outer cylinder at the depth as marked.



To trigger a sample when rainfall accumulates at 2.0 inch, insert the sensor in the outer cylinder at the depth as marked.

The water sensor and pickup hose should be installed in a storm water discharge channel or stream that is appropriate for your sampling program. The water sensor and pickup hose can be installed in the following manner:

1) Securely insert a piece of rebar or similar mounting material into the center of the storm water discharge channel or stream. The material should extend from the bottom of the channel at a distance appropriate for sensor installation (see step 2). Avoid installation where water may pool.

2a) In a dry channel, fasten the water sensor and the end of the pickup hose onto the mounting material using tie wraps, electrical tape, or hose clamps. Ideally, the pickup strainer should be placed at 1/2 the depth of flow during a storm event. The water sensor should be tied just above the debris strainer, in order to trigger a sample after the sample intake is submerged. The water sensor and pickup hose should be situated to avoid contact with the channel bottom.

2b) In a stream, fasten the end of the pickup hose onto the mounting material using tie wraps or hose clamps. The pickup strainer should be submerged under water and should be situated to avoid contact with the channel bottom. For stream sampling (as opposed to dry channel sampling) only the rain sensor will be used to trigger a sample.

3) For dry channel sampling, plug water sensor into "Water Sensor" socket on the control panel. For stream sampling, the bypass plug must be installed in the "Water Sensor" socket.

Securely insert a piece of mounting material into the center of the channel.

In a dry channel, the water sensor should be tied just above the debris strainer.

In a stream, the pickup strainer should be submerged under water.



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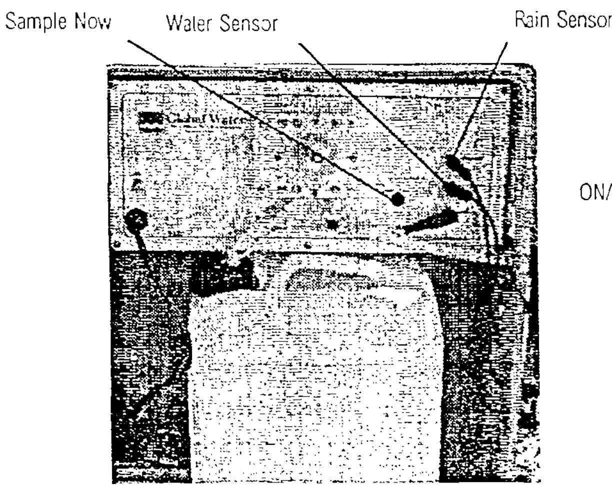
# Operation

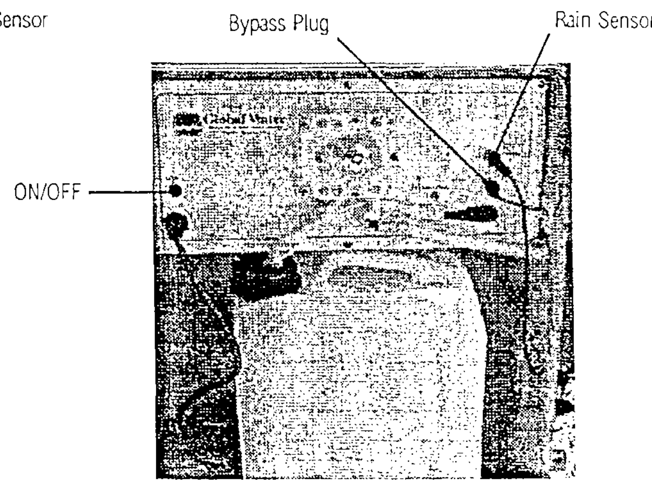
## Sampler

Verify that the sampling unit, rain gauge, water and rain sensors, and sampling pickup hose are installed correctly (see previous section). The Global Water SS101 Stormwater Sampler will function only if the battery plug is securely fastened into the appropriate socket on the control panel, the bottle plug is inserted into the "Bottle SW" socket, and either:

- both the rain sensor and water sensor are plugged into the appropriate sockets on the control panel (i.e., both sensors must be submerged to trigger a sample), or
- the rain sensor or water sensor is plugged into its appropriate socket and the bypass plug is inserted into the remaining socket (i.e., only the sensor that is plugged in must be submerged in order to trigger a sample).




Sampler with both sensors used to trigger a sample



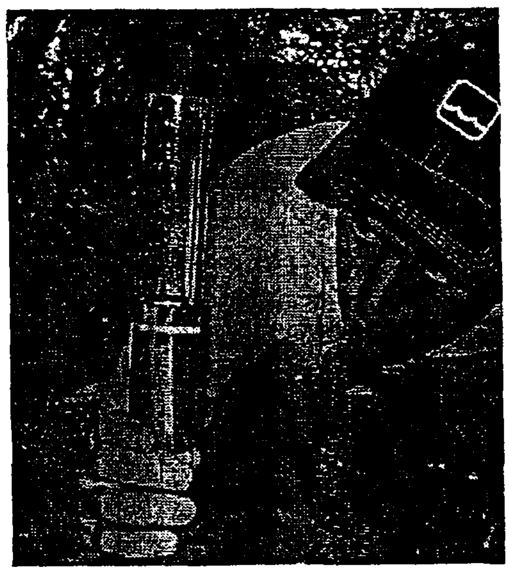

Sampler with one sensor used to trigger a sample (bypass plug in use).

Turn the sampling unit ON (switch is on the control panel) and verify that the sampler is operating using the "Sample Now" switch. The "Sample Now" switch can also be used to take manual samples. If the "Sample Now" switch does not run the pump, verify that the unit was installed and set up correctly (see above) and that the battery is recharged (see Maintenance section). If the unit still does not sample, refer to the Trouble Shooting section. The unit must be ON to take automatic samples.

The sampler will take approximately a 2.5 L sample. The sampler has a backflush function that will clear the pickup hose and pickup strainer after a sample is complete. The float switch in the bottle cap will turn off the sampler before the sample bottle overflows. After a storm, remove the sample bottle or transfer the sample to a small bottle for lab or turbidity meter analysis. Then, install an empty, clean bottle.

The top funnel of the Rain Gauge catches the rain and delivers it to the measuring tube. When over one inch of rain falls before the gauge is emptied, water will spill out of the measuring tube into the outer cylinder.

Rainfall of less than one inch can be read directly from the measuring tube by standing the measuring tube on a level surface and reading the amount to the nearest 100th of an inch. This measurement can then be recorded in a rainfall log (sample log provided). For rainfall over one inch, empty the measuring tube containing the first 1.00 inch of rain. Using the top funnel, carefully pour water from the outer cylinder into the measuring tube (if there is more than one inch of rain in the outer cylinder, pour out the measuring tube and repeat). Measure and record the total amount of rainfall, being sure to count the first inch of rain that was in the measuring tube.



Place the measuring tube on a level surface and read the rainfall amount to the nearest 100th of an inch.

**Georgia's NPDES Permit Sampling Requirements**

As required by the Permit, samples from automatic samplers must be collected no later than the next business day after their accumulation. Rainfall must be measured and recorded every 24 hours. We recommend establishing a convenient time each day to check and collect (if necessary) samples and record rainfall.

# Maintenance

## Sampler

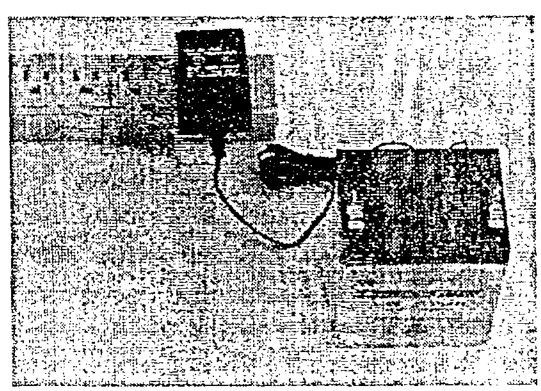
The Global Water SS101 Stormwater Sampler requires minimal maintenance. The sampler enclosure is rain-proof and rugged. Prevent exposure to extremely rough usage. Routinely wipe the carrying case and control panel face, rinse the pickup hose and debris strainer, and wash the sample bottle with mild soap and warm water. Additional plastic and glass sample bottles, norprene tubing for the sampler pump, bottle caps/float switches, removeable debris strainers, sensors, and pickup hose can be purchased from Global Water (see Accessories section).

## Rain Gauge

The sampler's Rain Gauge requires minimal maintenance. Wash the Rain Gauge periodically with mild soap and warm water using a household bottle brush. Do not use solvents or abrasives to clean the gauge and do not wash the gauge in a dishwasher. Do not allow accumulated water to freeze in the gauge and avoid extremely rough usage.

## Battery

The battery will last without requiring recharging through several storm events. If the pump grinds slowly, this is an indication that the battery requires recharging. We recommend fully recharging batteries approximately once per month. In addition, the battery should be recharged before any extended use. To recharge the battery, unfasten it from the control panel, slide it out of the carrying case, and unhook the cord from the battery terminals. Then, fasten the battery charger's disconnects onto the battery terminals and plug the charger into a wall socket. Full recharge will take about 12 hours. Additional batteries and battery chargers are available from Global Water (see Accessories section).



To recharge the battery, fasten the charger's disconnects onto the battery terminals and plug the charger into a wall socket.

## Troubleshooting

If your Global Water SS101 Stormwater Sampler does not seem to be functioning properly:

- Refer to the manual for proper setup, check all connections and power supplies. Manuals and additional technical information can be viewed on Global Water's web page (www.globalw.com).

- Call Global Water for technical support at (800) 876-1172 or (916) 638-3429 (many problems can be solved over the phone). You can also fax [(916) 638-3270] or e-mail (globalw@globalw.com) Global Water a detailed description of problems relating to your product.

- If your equipment needs to be returned to the factory for any reason, please call Global Water to obtain a RMA number (Return Material Authorization). Do not return items without a RMA number displayed clearly on the outside of the package.

- When contacting Global Water for technical support, please have the following information accessible:

  Product name and model number
  Unit serial number
  Purchase Order Number (if applicable)
  Global Water invoice number
  Detailed description of problems relating to the product

## Global Water Warranty

Our goal is to provide you with the finest water instrumentation at a reasonable price. Our products are always fully supported and 100% guaranteed.

Global Water warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from factory. Global Water's obligations under this warranty are limited to, at Global Water's option: (i) replacing, or (ii) repairing any products determined to be defective. In no case shall Global Water's liability exceed the product's original purchase price. This warranty does not apply to any equipment that has been repaired or altered by anyone but Global Water, or which has been subjected to misuse, negligence, or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty merchantability.

# Regulations Overview

### Construction Site Storm Water Sampling:

### Georgia's National Pollutant Discharge Elimination System (NPDES) Permit[1]

Georgia's Department of Natural Resources General Permit No. GAR100000 - Authorization to Discharge Under the National Pollutant Discharge Elimination System, Storm Water Discharges Associated with Construction Activity became effective August 1, 2000. The permit strongly encourages the use of automated water sampling equipment.

Although it can be used for a variety of applications, the Global Water SS101 Stormwater Sampler was specifically designed to meet Permit No. GAR100000's storm water sampling requirements. The Permit requires that storm water samples[2] be taken at construction sites between 5 and 250 acres, as well as at smaller sites that are part of a common development, within 45 minutes following either:

- the collection of a specified amount of rainfall after storm water runoff begins; or
- the beginning of storm water runoff after the collection of a specified amount of rainfall.

The Permit also requires that samples be taken at the following frequency[3]:

- the first rainfall event greater than or equal to 0.5 inches in 24 hours;
- any rainfall event greater than or equal to 1.0 inch in 24 hours (but only one 1.0 inch event per month needs to be sampled until final stabilization);
- any rainfall event greater than or over 2.0 inches in 24 hours until final stabilization;
- one rainfall event greater than or equal to 0.5 inches in 24 hours after final stabilization; and
- any rainfall event greater than or equal to 0.5 inches in 24 hour if Best Management Practices have not been properly designed, installed or maintained in accordance with the Permit.

In addition, rainfall must be measured and recorded once every 24 hours. The SS101 uses a rain gauge that was developed and is manufactured to United States Weather Bureau specifications.

To meet the Permit's sampling requirements, the Global Water SS101 uses two sensors to start an automatic sample: the rain sensor and the water sensor. The sensors can also be used to trigger samples independently. The rain sensor is positioned in a rain gauge and can trigger a sample at 0.5, 1.0, and 2.0 inch rainfall events. The water sensor is positioned in a storm water runoff channel where it will trigger a sample when runoff begins.

[1] This information is presented for general application overview only and should not be considered a replacement for fully reading and understanding Permit No. GAR100000 -Authorization to Discharge Under the National Pollutant Discharge Elimination System, Storm Water Discharges Associated with Construction Activity.

[2] Storm water discharge sampling locations are identified for each site in a Comprehensive Monitoring Program, prepared and certified by a professional licensed by the State of Georgia.

[3] Based on average rainfall in Georgia, it appears that there will be about 12-18 qualifying rainfall events per year.

## Accessories

| Part Name | Part Number | Unit |
|---|---|---|
| Removeable Battery | BAT003 | Each |
| Battery Charger | GB011 | Each |
| 1 Gallon Glass Sample Bottle | GL066 | Each |
| Bottle Cap/Float Switch | SS003 | Each |
| Rain Gauge | SS005 | Each |
| Pickup Hose | SS017 | Per/ft. |
| Removeable Sample Pickup | SS025 | Each |
| Norprene Peristaltic Pump Tubing | SS060 | Each |
| Rain and Water Sensors with 15' Cable | SS063 | Each |
| 2.5 Gallon Plastic Sample Bottle | WS001 | Each |

Please contact Global Water or visit our website (www.globalw.com) for unit prices.

# Stormwater Sampler Rain Gauge Daily Log

1. Try to record precipitation each day at the same time.
2. Record precipitation to the nearest 1/100 of an inch. (.01, .31. 1.31, etc.)
3. If precipitation is less than .01, record "T" for Trace.
4. Use the remarks column to list any unusual weather.

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